United States
Department of
Agriculture

Draft Environmental Assessment

Lee Creek Fuels Treatment Project

Ozark-St. Francis National Forest

Boston Mountain Ranger District
Lee Creek Unit
Crawford and Washington Counties Arkansas

Responsible Official
William Dunk
District Ranger
Boston Mountain
Ranger District

For Information Contact:
Boston Mountain Ranger District
1803 North 18th St
Ozark, AR 72949
479-667-2191

Forest
Service
March 2015

The U.S. Department of Agriculture (USDA) prohibits discrimination in all its programs and activities on the basis of race, color, national origin, gender, religion, age, disability, political beliefs, sexual orientation, or marital or family status. (Not all prohibited bases apply to all programs.) Persons with disabilities who require alternative means for communication of program information (Braille, large print, audiotape, etc.) should contact USDA's TARGET Center at (202) 720-2600 (voice and TDD). To file a complaint of discrimination, write USDA, Director, Office of Civil Rights, Room 326-W, Whitten Building, 14th and Independence Avenue, SW, Washington, DC 20250-9410 or call (202) 720-5964 (voice and TDD). USDA is an equal opportunity provider and employer.

TABLE OF CONTENTS

1.0 PURPOSE AND NEED FOR ACTION 4
INTRODUCTION 4
1.1 PURPOSE AND NEED 6
1.2 MANAGEMENT DIRECTION 7
1.3 RELATIONSHIP TO OTHER LAWS AND REGULATIONS 10
1.4 DECISION TO BE MADE 11
1.5 SCOPING AND KEY ISSUES CONSIDERED 11
1.6 COMMENT AND OBJECTION OPPORTUNITIES 12
2.1 ALTERNATIVE 1 – PROPOSED ACTION 14
2.2 ALTERNATIVE 2 – NO ACTION 18
2.3 MANAGEMENT REQUIREMENTS & MITIGATION MEASURES (DESIGN CRITERIA) 18
2.4 MONITORING 23
3.0 AFFECTED ENVIRONMENT AND ENVIRONMENTAL CONSEQUENCES 24
3.1 AIR QUALITY 26
3.2 SOILS AND WATER 30
3.3 VEGETATION 39
3.4 WILDLIFE 42
3.5 SAFETY AND HUMAN HEALTH 77
4.0 LIST OF PREPARERS AND AGENCIES/PERSONS CONSULTED 80
5.0 REFERENCES 81

LISTS OF FIGURES AND TABLES

FIGURES

Figure 1. Lee Creek Fuels Treatment Project Vicinity Map 5
Figure 2. Condition Classes for the Lee Creek unit 15
Figure 3. Subwatersheds in vicinity of proposed prescribed burning 33
Figure 4. Boston Mountain Ranger District Bird Count Data 1997-2013. 49

TABLES

Table 1. Management Areas in the Lee Creek Unit 8
Table 2. Air Quality Index (AQI) for pollutants 27
Table 3. Subwatersheds within the Lee Creek Unit 32
Table 4. Future Projects in the subwatersheds of the Lee Creek Unit. 35
Table 5. MIS Species, Habitat Requirements and Population Trends 43

1.0 PURPOSE AND NEED FOR ACTION

INTRODUCTION

The Boston Mountain Ranger District of the Ozark-St. Francis National Forests, USDA Forest Service is proposing to conduct fuels reduction activities through prescribed burning and/or mechanical removal on approximately 57,480 acres of federal property within the 100,000 acres proclamation boundary of the Lee Creek Unit in Crawford and Washington counties in Arkansas over the course of the next several years (figure 1). None of the activities would occur on private land unless an agreement between a landowner and the Forest Service has been reached. The proposed activities are referred to as the *Lee Creek Fuels Treatment Project.*

Decades of fire suppression in the Lee Creek Unit has resulted in a buildup of fuels, the dominance of early successional trees with reductions of overstory diversity, and declines in the quality of open areas for wildlife forage. Additionally, natural mortality caused by red oak borer infestations, high wind events and several severe droughts over the last decade has increased the volume of dead trees across the landscape. The Wildland Urban Interface (WUI), areas where National Forest lands are adjacent to private developed land, makes up 63% of the Lee Creek Unit (figure 1). These areas are at increased danger from the threat of wildfires.

Controlled or prescribed burning and mechanical fuels removal are appropriate management tools to improve wildlife habitat and viewing opportunities while reducing the spread of non-native invasive vegetation and insect pests. Prescribed burning visually enhances recreational settings and reduces fuel buildup for protection of infrastructure from catastrophic wildfires. Other benefits to the area would include stimulation of nutrient recycling: by increasing the amount of sunlight reaching the forest floor, growing conditions improve for small herbaceous plants and forbs, increasing browse and soft mast production for wildlife.

This project includes eradication of non-native invasive species on openings or along roadsides through mechanical or herbicide treatments. No more than 1,000 acres would be sprayed for various herbicide-related treatments in the course of any one year. This includes spot spraying (highly localized) with herbicide as needed throughout the life of this project (approximately ten years).

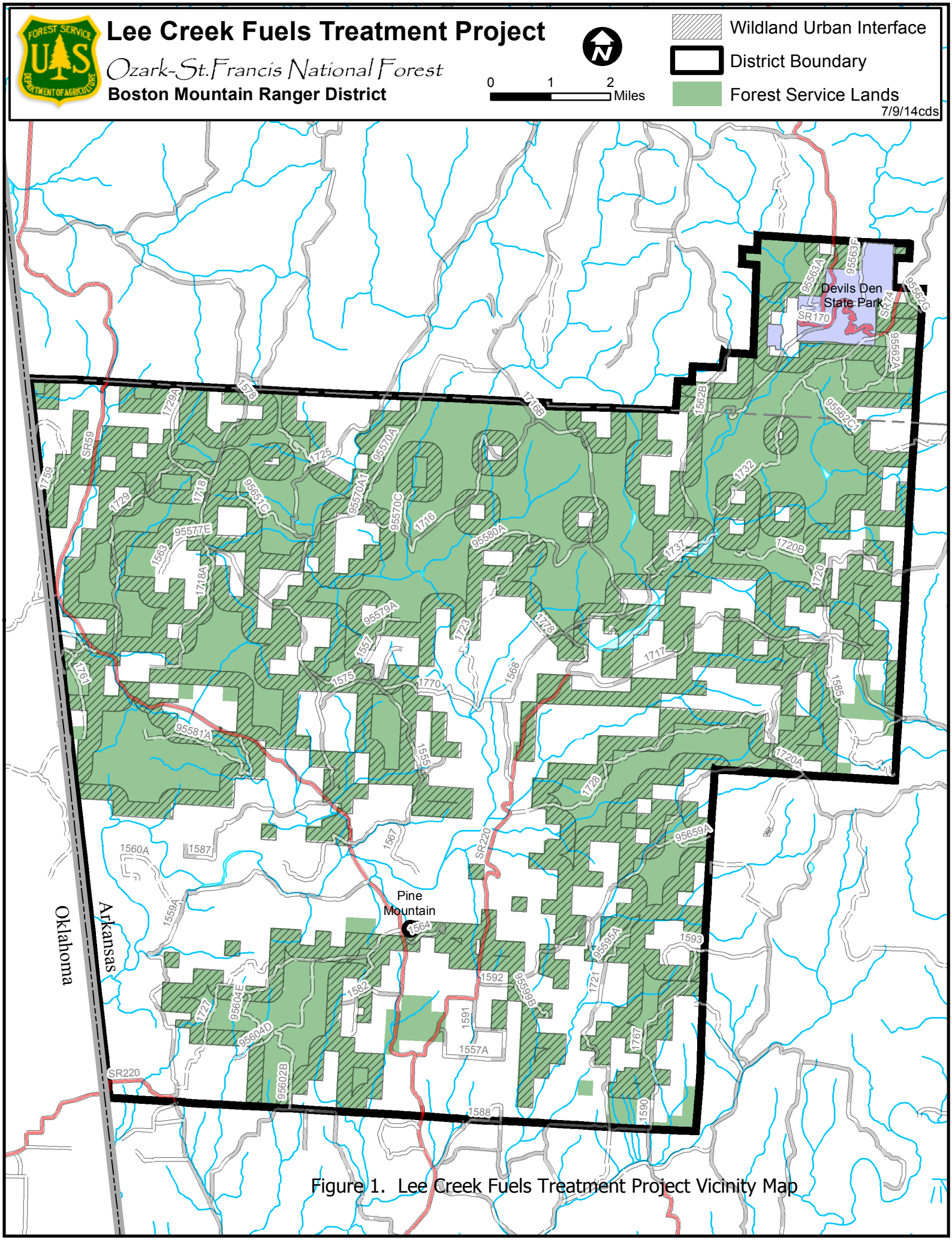

Figure 1. Lee Creek Fuels Treatment Project Vicinity Map

This Draft Environmental Assessment (EA) has been prepared in compliance with the National Environmental Policy Act (NEPA) of 1969 (42 U.S.C. 4321-4347, January 1, 1970) and other relevant federal and state laws and regulations. The EA discloses the direct, indirect, and cumulative impacts that would result from the proposed action, and alternative to the proposed action. The document is organized into six sections:

1.0: Purpose and Need for the Action: This section includes detailed information about the project proposal, the purpose and need for the project, the Forest Service's proposal that addresses the purpose and need, and a summary of the public involvement process.

2.0: Comparison of Alternatives: This section provides alternatives to the proposal. The section also includes design criteria, or measures that are taken to prevent potential adverse effects of an action.

3.0: Affected Environment and Environmental Consequences: In this section the potential environmental impacts of each of the alternatives are examined. The section is organized by the environmental resource being examined.

4.0: Consultation and Coordination: This section provides a list of preparers and agencies consulted during the development of the environmental assessment.

5.0: References: This section provides a list of references and data sources used in the analysis.

6.0: Appendices: The appendices include larger maps with more detail and other information used to support the analysis presented in the EA.

1.1 PURPOSE AND NEED

The purpose of this project is to reduce the hazard of wildfire to protect forest resources and enhance watershed conditions, improve wildlife habitat and restore ecosystems. Healthy forests and watersheds, a diversity of plant and animal species, safe and suitable access to the forest, a balance of traditional and emerging recreational opportunities, and continued local economic support are the desired future conditions for the project area as well as the Ozark National Forest as a whole.

Wildfire is one of many natural processes across the landscape supporting watershed functions, plant diversity, and wildlife, but we cannot depend on these forces of nature alone to maintain these services under current conditions. The proposed fuels treatments are a safe way to mimic a natural process, ensure ecosystem health, and reduce wildfire risk and impacts. The proposed treatments would reduce amounts of overgrown vegetation and debris that support wildfire growth.

Conditions within the project area include overstocked stands with over-abundant mid-story component, and hazardous fuels buildup due to windthrow, a recent ice storm, and insect outbreaks. In addition, the structure and species composition within these stands is changing because of past fire suppression. If left untreated, these communities and the wildlife and plants that depend on them could be reduced across the landscape. The higher potential for wildfires could also cause excessive damage to vegetation, wildlife, and soils.

Many areas are infested with non-native invasive species such as privets, kudzu, serecia lespedeza, and multiflora rose. Tree encroachment, especially eastern red cedar on openings is threatening to change the character of these special habitats. Woody vegetation and non-native invasive species (NNIS) are encroaching on pastures, openings and utility rights-of-way resulting in poor quality wildlife habitat.

Healthy, resilient forests and trees filter our water, help cities and towns conserve energy, and contribute to a diversity of plant and animal species. These are the desired future conditions for the project area as well as the Ozark National Forest as a whole.

1.2 MANAGEMENT DIRECTION

The Revised Land and Resources Management Plan for the Ozark-St. Francis National Forests (hereafter referred to as the Forest Plan) set the overall guidance for managing the land and resources of the Ozark-St. Francis National Forests. This document is available on the web at:
http://www.fs.usda.gov/Internet/FSE_DOCUMENTS/fsm8_042809.pdf

The actions proposed were developed from these conditions described and based on the goals and standards established by the Forest Plan. The interdisciplinary team proposing these actions consists of foresters, biologists, archaeologists, a recreation specialist, engineering technician, and fire management officers. This analysis is tiered to the Final Environmental Impact Statement (FEIS) for the Forest Plan.

The Forest Plan calls for the use of a combination of prescribed burning, mechanical and vegetation treatments to lower the risk of catastrophic wildfire and restore fire-adapted ecological communities. Forest-wide objective (OBJ).57 states that Forest-wide, hazardous fuels reduction activities should be completed on between roughly four and eight percent (50,000 to 100,000 total acres) of the Ozark-St. Francis National Forests' lands annually.

The Indiana bat, considered by the Fish and Wildlife Service as a federally listed endangered species, is known to occur within the analysis area. The Forest Service has identified areas within five miles of where Indiana bats are likely to hibernate during the winter as 'secondary zones' in the Forest Plan. Secondary zones are used most

frequently as roosting and foraging habitat. Areas within a one-quarter mile of hibernation areas are called 'primary zones'. Secondary zones are used most frequently as roosting and foraging habitat. About 14,624 acres of the proposed project area in the upper northeast corner is within a secondary zone and about 125 acres of the project area is within a primary zone.

Within the primary and secondary zones for the Indiana bat, Forest Plan standards FW47 and FW48 provide direction to develop foraging habitat through regulation and maintenance of optimal overstory density (60 to 80 percent canopy closure for primary zone and 50 to 70 percent for secondary zones) using timber harvest, non-commercial thinning and prescribed fire. The actions proposed in this project would contribute toward achieving the optimal over-story density to benefit both hibernation and foraging habitat for this endangered species. Standards for management practices in the Indiana Bat Zone areas are more stringent than those for Forest Plan Management Areas.

All lands managed by the Forest Service within the unit are in the following management areas (table 1).

Table 1. Management Areas in the Lee Creek Unit

Acres in Project Area	Management Area and Resource Emphasis
50,308	3B - OAK WOODLAND- To restore and maintain a landscape mosaic of open oak woodland that approximates historical conditions. The purpose is to provide habitat for associated plants and animals, some of which are rare and declining, and to create a setting for recreation that is visually appealing, rich in wildlife, and not commonly encountered elsewhere. In the project area, there are significant inclusions of pine stands. In this case restoration and maintenance of pine woodland is appropriate.

Acres in Project Area	Management Area and Resource Emphasis
4,364	3A - PINE WOODLAND- The primary emphasis in this management area is to restore and maintain a landscape mosaic of open pine woodland that approximates historical conditions. The purpose is to provide habitat for associated plants and animals, some of which are rare and declining, and to create a setting for recreation that is different, uncommon, visually appealing, and rich in wildlife. Restoration and maintenance of pine woodland occurs primarily on xeric and dry sites within this management area. Where oak dominates on oak-appropriate sites, restoration and maintenance of oak woodland is also emphasized. On more mesic sites, management emphasis varies as needed to provide for other multiple uses and values that are compatible with the primary emphasis of this area.
1,299	3I - RIPARIAN CORRIDORS-Managed to retain, restore, and enhance the inherent ecological processes and functions of the associated aquatic, riparian, and upland components within the corridor. Primarily, natural processes (floods, erosion, seasonal fluctuations, etc.) modify most of the areas within the riparian corridor. Management activities may be used to provide terrestrial or aquatic habitat improvement, favor recovery of native vegetation, control insect infestation and disease, comply with legal requirements (e.g., Endangered Species Act, Clean Water Act), provide for public safety, and meet other riparian functions and values.
535	3J - PASTURES AND LARGE WILDLIFE OPENINGS- This area is unsuitable for timber production. The objective is to provide permanent forage and cover for livestock and wildlife.
135	2C - DEVELOPED RECREATION AREAS- Managed to provide the public with a variety of recreational opportunities in visually appealing and environmentally healthy settings. Facilities are provided to enhance the quality of the recreational experience and to mitigate damage to the affected ecosystems. These areas also serve as "gateways" to the wide diversity of recreation opportunities on the remainder of the forests.

The Lee Creek Unit is associated with two public supply waters. A small portion of the unit is with Washington Water Authority (about 25 acres) while over one-quarter of the unit (25,787 acres) is with Cedarville Water Works.

The City of Fort Smith runs a water quality monitoring program in several of the subwatersheds in the Lee Creek Unit which includes quarterly sampling of five tributaries contributing source water to Lee Creek: Mountain Fork Creek, Cove Creek, Upper Lee Creek, Little Lee Creek and Buckhorn Creek.

1.3 RELATIONSHIP TO OTHER LAWS AND REGULATIONS

The Clean Air Act requires the Environmental Protection Agency (EPA) to establish National Ambient Air Quality Standards (NAAQS) for six pollutants considered harmful to public health and the environment: carbon monoxide, lead, nitrogen dioxide, ozone, particulate matter, and sulfur dioxide. The standards were set at the level required to provide an ample margin of safety to protect the public health.

The Endangered Species Act (1973): Authorizes the determination and listing of species as endangered and threatened; requires federal agencies to insure that any action authorized, funded or carried out by them is not likely to jeopardize the continued existence of listed species or modify their critical habitat. Section 7(a) (1) of the act identifies the affirmative conservation duties of agencies and requires all federal agencies to carry out programs aimed at recovery of listed species.

Under the **National Forest Management Act** (NFMA) regulations, selection of management indicator species (MIS) during development of forest plans is required. MIS are selected because their population changes are believed to indicate the effects of management activities. They are used during planning to help compare effects of alternatives and as a focus for monitoring. Where appropriate, MIS represent the following groups of species (36 CFR 219.19 [a] [1]):

- Threatened and endangered species on state and federal lists
- Species with special habitat needs
- Species commonly hunted, fished or trapped
- Non-game species of special interest
- Species selected to indicate effects on other species of selected major biological communities.

Wetlands are areas that are inundated or saturated by surface or groundwater at a frequency and duration sufficient to support, and that under normal circumstances do support, a prevalence of vegetation typically adapted for life in saturated soil conditions. Wetlands generally include swamps, marshes, bogs and similar areas (40 CFR Parts 122.2, 230.3, and 232.2). Formal wetland definitions have been developed by several federal agencies in the United States. These definitions include considerable detail and are used for regulatory and management purposes (see http://water.epa.gov/lawsregs/guidance/wetlands/quality.cfm). Any identified wetlands in the project area as defined by **Executive Order 11990 (Wetland Protection)**, and Section 404 Regulations of the **Clean Water Act** would be protected.

The **National Historic Preservation Act of 1966**, as amended (NHPA), requires federal agencies to take into account the effects of federal undertakings on historic properties and afford the Advisory Council on Historic Preservation (ACHP) a reasonable opportunity to comment on such undertakings. Additionally, federal agencies are

required to follow the implementing regulations of the ACHP set forth in 36 CFR Part 800. Specifically, 36 CFR Part 800 requires that State Historic Preservation Offices and federally-recognized Tribes be consulted about any undertaking that has the potential to affect historic properties and/or properties of religious or cultural significance at the earliest possible stage in the planning process. Protocols for cultural resource reviews, surveys, and reporting are specified by a Programmatic Agreement (PA) between the U.S. Forest Service, relevant federally-recognized Tribes, and State Historic Preservation Offices (SHPO) of Arkansas and Oklahoma, signed in 2006 and extended in 2011, 2012, and 2013.

1.4 DECISION TO BE MADE

The decision to be made is whether or not to approve the management activities as proposed, defer all activities until another time, require additional information from the Interdisciplinary Team if the information presented is not adequate to make a decision, or require the development of an Environmental Impact Statement or other NEPA Document.

1.5 SCOPING AND KEY ISSUES CONSIDERED

Scoping is defined by the National Environmental Policy Act as "an early and open process for determining the scope of issues to be addressed, and for identifying the issues related to a proposed action." Scoping continues throughout project planning and analysis.

The Project was listed in the Schedule of Proposed Actions. In July 2014 a "scoping" letter and activity map was posted on the Ozark-St Francis National Forests website. In all, over 1200 letters were mailed to local landowners plus tribal and local governments and persons on the all-mail list.

The key issues associated with this project were identified through this public scoping process, which included input from Forest Service specialists, other government agencies, and private individuals. The comments and Forest Service responses are part of the project file and may be viewed at the district office. Seven comments were received in response to the proposal. Two commenters voiced concerns about burning near private property and structures. These comments were addressed in telephone calls to the commenters from the district Fire Management Officer (FMO). One mentioned the possibility that the Forest Service would be '*taking down 63% of the forest's natural foliage areas*.' We assured the commenter that this was not the case. The City of Fort Smith requested notification prior to burns of over 200 acres in the watershed. The Forest Service is committed to the maintenance and improvement of water quality in this area. Part of the City's concern is that after burns, Total Organic

Carbon (TOC) concentrations in streams downstream of the burns may become elevated. The FMO has agreed to notify the city before the burns so that remote monitors may be employed. Another person was concerned about the possibility of disturbance to turkey nests which was addressed in a letter from the District Wildlife Biologist. While it is possible that some burning may occur during nesting season and could destroy individual nests, the overall effect to the turkey population would be beneficial from landscape level burns. A Forest Service Interdisciplinary Team (ID Team) reviewed the comments received during the scoping period and determined that there were no issues that could not be addressed through project design or mitigation measures, and therefore no alternatives to the proposed action were developed to respond to issues that were identified in the scoping process. The comments and Forest Service responses are a part of the project record and may be viewed at the district office.

1.6 COMMENT AND OBJECTION OPPORTUNITIES

This project is subject to administrative review under 36 CFR 218 Project-Level Pre-decisional Administrative Review Process, Parts A and B.

The legal notice of the availability of this document in the *Southwest Times Record* (the newspaper of record for projects on the Boston Mountain Ranger District of the Ozark National Forest) starts the 30-day Notice and Comment period. Specific written comments about this project as defined by 36 CFR 218.2 should be within the scope of the proposed action, have a direct relationship to the proposed action, and must include supporting reasons for the responsible official (district ranger) to consider. It is the responsibility of all individuals and organizations to ensure that their comments are received in a timely manner.

Comments received in response to this solicitation, including names and addresses of those who comment, will be considered part of the public record and will be available for public inspection. Comments submitted anonymously will be accepted and considered; however we will not be able to provide the respondent with subsequent environmental documents.

An objection period, if required, will follow the regulation found in 36 CFR 218.7. For objection eligibility (36 CFR 218.5), only those who have submitted timely, specific written comments during any designated opportunity for public comment may file an objection. Issues to be raised in objections must be based on previously submitted specific written comments regarding the proposed project and attributed to the objector, unless the issue is based on new information that arose after a designated opportunity to comment (36CFR 218.8(c)).

Our mailing address is: U.S. Forest Service, 1803 N 18th Street, Ozark, AR 72949. You may also call, or email your comments to: *comments-southern-ozark-stfrancis-bostonmtn@fs.fed.us*. Please state "Lee Creek Fuels Treatment Project" in the subject line when providing electronic comments, or on the envelope when replying by mail. If you have questions on this environmental assessment, the proposal or the analysis decision process, please call Jobi Brown or William Dunk at 479-667-2191.

2.0 ALTERNATIVES

This section presents a detailed description of the proposed action and the no action alternative. The proposed action alternative was developed by the Interdisciplinary Team of specialists in response to issues and opportunities identified in the area.

2.1 ALTERNATIVE 1 – PROPOSED ACTION

Prescribed Burning and Mechanical Fuels Reduction

The entire project area would not be burned all at one time. Burn areas would be sub-divided into more manageable burn units usually ignited on separate days. On a rotational basis, specific units would be identified to burn each year based on Forest Plan objectives and guidelines as well as fuel and weather conditions. For example, for some areas the goal is improving wildlife habitat and particular seral stages rather than bringing back the full array of historical vegetation. Burn units may be burned more than once to mimic the natural fire regime and meet management objectives. Burn frequency following initial burns would also be based upon monitoring, but would likely be every three to five years. The management activities in this alternative would start in 2015.

A standardized tool for determining the degree of ecological departure from historical or reference conditions is the Fire Regime Condition Class metric, FRCC. The Fire Regime denotes the frequency and intensity of burns. Values of one through three denote low, moderate and high departure respectively. Forest Objective 16 states that within 15 years restore 15-20% of all ecological communities into FRCC 1 (RLRMP page 2-26). For most of the Lee Creek Unit the Fire Regime value is 1 (0-35 year frequency of low to mixed severity). However, the condition class (CC) of the unit is dominated by CC 2 and CC 3 indicating the fire regime has been moderately to significantly altered from the historical range. The potential exists, with current fuel loadings which have been caused by disruption of fire regimes, for large scale wildfires which could cause extensive resource damage and damage to private lands and developments. Condition classes of 2 and 3 are identified as the highest priority for fuels reduction and ecosystem restoration treatments (Figure 2).

Post burn evaluations would be conducted to determine treatment effectiveness and to determine the return interval and burning season most likely to lead toward accomplishment of management objectives. Past post-burn evaluations in this area have indicated that burning meets objectives by reducing hazardous fuels, opening the understory, and temporarily reducing competition for mast bearing hardwoods from red maple, eastern red cedar, black gum and other fire-intolerant pioneer species.

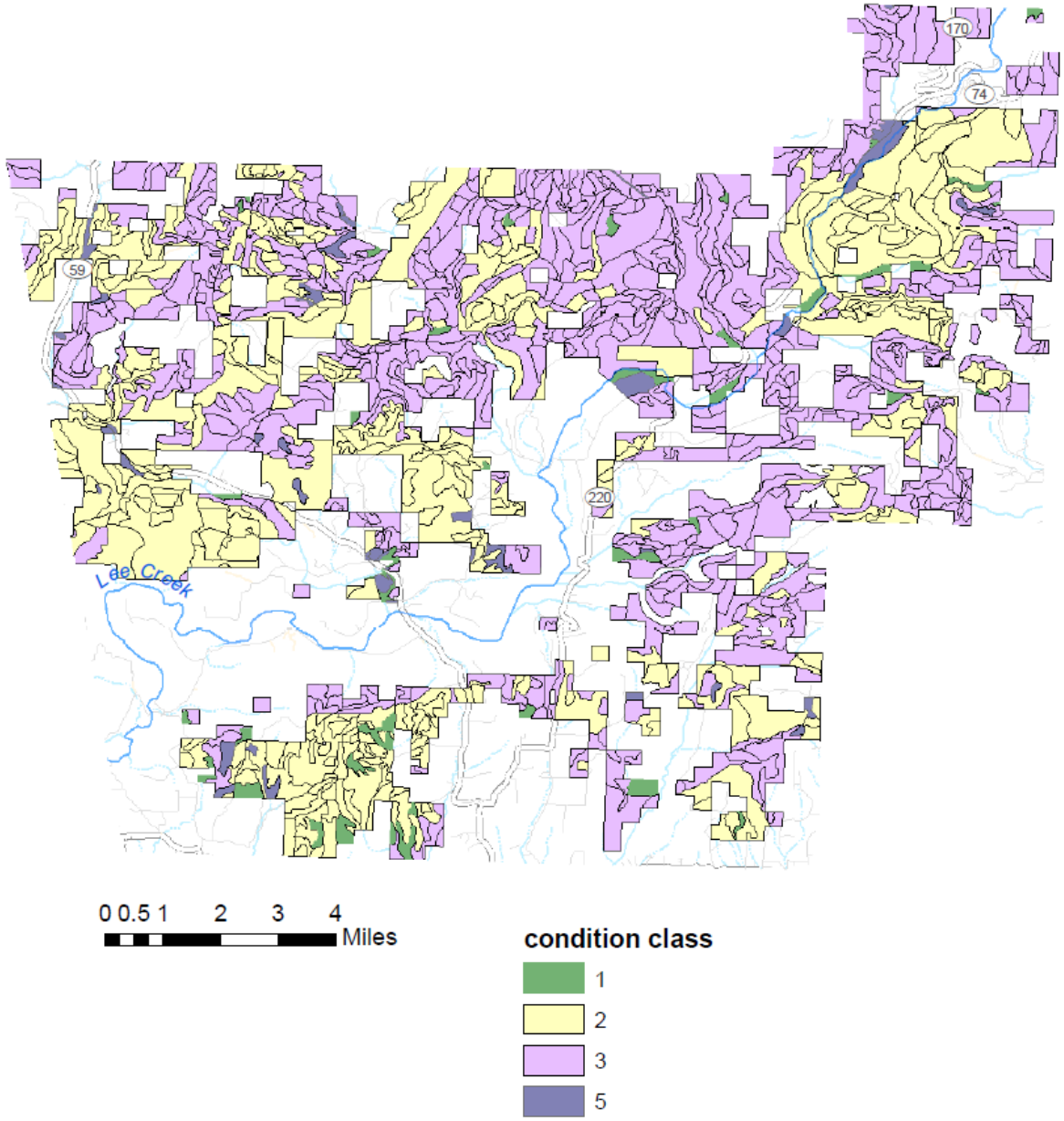

Figure 2. Condition Classes for the Lee Creek unit

Objectives specific to particular burn units include restoring ecosystems, reducing fuels, reducing small stem densities (in the one and two-inch size classes) by 60 to 80%, reducing the cedar component in pine stands by 50%, and improving aesthetics.

Dormant season prescribed burns would be conducted to restore and maintain forest and special communities and reduce burnable fuels (litter, slash, down timber, standing snags). Growing season burns would be conducted to promote understory growth of fire tolerant species and diversity as well as reduce mid-story stem density which can serve as ladder fuels and block diffuse light reaching the forest floor. The dormant

season for burning in the South generally runs from October 1st through April 14th while a growing season burn generally runs from April 15th through September 30th. However, this varies based on climatic conditions that influence “leaf out” for the start of the growing season and “hardened off” that signal the start of the dormant season. To reduce competition from woody shrubs and other tree species, some burning would occur after the spring flush of foliage. Growing season burns would be applied in areas being restored and maintained for woodland conditions over the long term.

The burns would reduce the existing litter layer. This is the layer of materials on the forest floor that has not yet begun to decompose significantly and can readily be distinguished as twigs, leaves and other living or recently living materials. However, the majority of the duff layer would remain intact. The duff layer is between the uppermost soil mineral horizon and the litter layer. Material in the duff layer is decomposed to the point at which there are no identifiable organic materials (leaves, twigs, etc.).

There are a variety of methods commonly used to ignite burn units. Some of the methods used most often by the Forest Service are: hand ignition with drip torch, flare guns, and aerial ignition. All of these would likely be used for this project. Ignition of separate units may be done with the use of a helicopter and/or hand crews.

Fire would be allowed to back down from ridge-tops into hollows and drains; vegetated buffers would be maintained along perennial streams as directed by the Forest Plan. Existing roads, streams and control lines established for previous prescribed burns within the proposed project area would be used as control lines where practicable.

Where suitable firebreaks are not already in place, construction of new prescribed fire control lines may be required. There may be as much as thirty miles of new fire line needed throughout the entire project area to protect timber regeneration areas. Fire line construction varies greatly in ground disturbance potential. For example, dozer lines compact and erode soils to a greater degree than hand line which in turn is more disturbing than broadcasting water along a burn perimeter. Prescribed fire control lines may be constructed with a bull dozer or similar equipment to clear dead vegetation and expose bare mineral soil, equipment with masticator capability, or with handtools or leaf blowers. Handtools or leaf blowers would be used where mechanically constructed line is unsuitable in unstable soils. Some lines may be used repeatedly over the course of years while some may be used just once. As soon as possible after completion of a burning operation, prescribed fire control lines would be seeded with a Forest-approved seed mixture to help speed natural recovery processes and reduce the potential for erosion.

Prior to mechanical construction of any new prescribed fire control line, surveys for sensitive resources would be required and the locations would be approved by Forest Service resource specialists.

To limit the potential for a burn to escape and to facilitate safety of prescribed burn personnel, existing snags and some live trees inside the burn unit or within 50 – 100 feet of burn unit perimeters may need to be felled or pushed over in advance of a scheduled burn date, during or immediately following a prescribed burn operation.

Protection measures for the controlled burns include burning within Forest Service guidelines and protecting travelers on major forest roads from reduced visibility due to smoke. The area would be monitored after burning by Forest Service personnel to assess the effectiveness of the prescribed burn.

Mechanical fuels treatments would include using mechanical equipment in conjunction with or in place of prescribed burning to help meet management and restoration goals. Mechanical fuels treatment, also known as mulching, shredding, mastication, or chipping, is a method of fuels treatment in which ladder fuels are chopped into smaller pieces, and standing live or dead fuels are converted to more compact surface fuels. Treating fuels mechanically in conjunction with prescribed burning typically allows fuels to burn more easily under controlled conditions. This may involve using an application-specific tractor called a forestry mulcher which has a rotary drum with steel teeth to shred vegetation. It may also include the use of a more general machine such as an excavator, or bulldozer with a mulching attachment. Mechanical fuels treatment increases the amount of coarse woody debris on the forest floor and can protect soils from erosion and help to retain nutrients.

Chemical Treatments

For all the application methods listed below, no more than 1,000 acres per year would be treated with herbicide in the course of a year.

Chemical Spraying for Non-native Invasive Species Eradication in Forested Areas, Roadsides and Trails: Eradication of NNIS along roadsides or trails (serecia lespedeza, tree of heaven, fescue, multi-flora rose, Japanese honeysuckle, Johnsongrass, silk tree, stiltgrass, non-native privets) would be accomplished by directed foliar application of Accord (glyphosate, isopropylamine salt formulation at four pints of active ingredient/acre). Rodeo (aquatic herbicide) would be used near any streams or rivers. Treatments would occur between May and September with July-August being the optimum period. Herbicide treated areas cannot be prescribed burned for at least 30 days after treatment. The following trees, shrubs, and plants – regardless of size and of treatment method – would not be treated: black cherry, dogwood, French mulberry, persimmon, serviceberry, plum, Ozark chinquapin, Kentucky lady slipper, royal catchfly, Ozark Trillium, Ozark spiderwort, and Ouachita leadplant.

Chemical Spraying for Fescue and Serecia Lespedeza Eradication in Pastures and Wildlife Openings: Direct foliar application of glyphosate (Rodeo or Accord) (glyphosate, isopropylamine salt formulation at 4 pints of active ingredient/acre) with tractor boom sprayer. Rodeo (aquatic herbicide) would be used near any streams or

rivers. Treatments would occur between May and September with July-August being the optimum period. Herbicide treated areas cannot be prescribed burned for at least 30 days after treatment. The following trees, shrubs, and plants – regardless of size and of treatment method – would not be treated: black cherry, dogwood, French mulberry, persimmon, serviceberry, plum, Ozark chinquapin, Kentucky lady slipper, royal catchfly, Ozark Trillium, Ozark spiderwort, and Ouachita leadplant.

Chemical Spraying for Woody Vegetation Eradication in Pastures and Wildlife Openings: Eradication of encroaching woody vegetation in pastures and wildlife openings would be accomplished through direct foliar/stem application of triclopyr (Garlon 4) at no more than two quarts/acre of active ingredient. Applications would occur from May through September, with July-August being the optimum time period. Herbicide treated areas cannot be prescribed burned for at least 30 days after treatment. The following trees, shrubs, and plants – regardless of size and of treatment method – would not be treated: black cherry, dogwood, French mulberry, persimmon, serviceberry, plum, Ozark chinquapin, Kentucky lady slipper, royal catchfly, Ozark Trillium, Ozark spiderwort and Ouachita leadplant.

2.2 ALTERNATIVE 2 – NO ACTION

This alternative proposes no activity that would move the area toward the desired conditions described in the Forest Plan. No resource activities would be carried out. Routine management outside the scope of the proposed action would continue at the present level including road maintenance, fire protection, timber management, and law enforcement.

2.3 MANAGEMENT REQUIREMENTS & MITIGATION MEASURES (DESIGN CRITERIA)

For the Proposed Action Alternative, applicable standards and guidelines in the Ozark-St. Francis Revised Land and Resources Management Plan (RLRMP), the mitigation measures and management requirements of the Trails Management Handbook (FSH 2309.18), and the Best Management Practices (BMP) Guidelines for Water Quality Protection (Arkansas Forestry Commission 2002) would be applied as appropriate for this project. Some of these standards and guidelines applicable to this project are summarized below. This list is not all-inclusive. The above documents should be referenced for a complete list.

Prescribed Burns and Mechanical Fuels Reduction

For each burn unit within the project area, a specific prescribed burn plan would be developed. Site-specific burn plans are prepared by a qualified fire management specialist and approved by the District Ranger and specialists prior to burning in each forest compartment or burn unit. These burn plans include a description of the

treatment area, burn objectives, and needed resource coordination requirements. The plans ensure all information regarding fuel loads, wildlife species, cultural resource considerations, and other pertinent natural resource data is current. Potential smoke management concerns around sensitive areas such as cities, towns, major roadways, and airports are considered as well. Weather and site conditions are considered "in prescription" when ambient temperatures, wind speed and direction, weather forecasts, and other criteria allow for effective burning without undue risk of extreme fire behavior or intensity. The burn plans are used to define appropriate burning conditions and burning strategies for each burn unit.

A morning briefing would be conducted the day of the burn to review safety guidelines, the location of control lines, the presence of any listed species or heritage sites, ignition methods, and strategies for mop-up and control to insure the fire is safe when completed. Notification of the appropriate agencies and adjacent landowners would be done the day of the burn. A post-burn evaluation would be conducted to determine if the burn achieved the specific objectives.

Burning operations would also follow the guidelines of the Arkansas Forestry Commission's Smoke Management Program (SMP), and be monitored to ensure project design criteria and smoke management activities are properly executed. The SMP guides prescribed fire managers to minimize the impact of particulate matter released into the atmosphere by estimating how many tons of fuel may be burned in an air shed. It is available at http://forestry.arkansas.gov/Services/KidsTeachersEveryone/Documents/ArkansasVSMG.pdf

When a burn date is tentatively scheduled for implementation, public notification efforts would be made in accord with the prescribed burn plan. In addition:

- Reasonable attempts to contact persons who have previously notified the District Office that they have a specific smoke sensitivity would be made.
- If requested, assistance would be provided to temporarily relocate those individuals during heavy smoke concentrations.

Prescribed burning activities would not be conducted on days declared by the National Weather Service as Ozone Action Days or if a smoke dispersion modeling analysis conducted before any scheduled burning operation begins indicates that smoke sensitive targets may be impacted and mitigation measures would not lessen or significantly reduce the impact. Smoke sensitive targets would be identified depending on the burn unit to be burned.

Prior to ignition, a contingency plan would be in place outlining actions to immediately address any change in meteorological conditions that fall outside the appropriate parameters and/or spotting outside the burn area. Key weather variables such as

transport winds and mixing heights would be continuously monitored to avoid smoke impacts to major metropolitan areas downwind. This would be accomplished in coordination with neighboring districts and fire dispatch.

Signs may be placed along public roads to warn the public of potentially smoky conditions. Should visibility along any road become impaired, motorists may be stopped and warned of the conditions. If conditions warrant, pilot cars may be utilized to lead vehicles through the area or roads may be temporarily closed.

Best Management Practices would be used to prevent erosion on constructed firelines and/or temporary roads. Seeding and installing water bars on these new lines would be employed as mitigation for erosion.

Unintended/undesired motorized vehicle access that may have been created by the construction of dozer lines would be restricted. Reestablishment of road closures and administratively desired roadway widths/conditions to pre-disturbance widths/conditions would be accomplished.

All safety precautions and BMP guidelines for use of bulldozers, tractors, and mechanical fuels treatment equipment would be followed when mechanical fuels treatments are implemented. This would include use of such equipment in appropriate areas which are not too densely vegetated and/or steep and rocky.

Herbicide Use

Herbicides would not be applied within 100 feet of private land or 300 feet of a residence. Spraying would be suspended if temperature, humidity, or wind becomes unfavorable as follows: Temperature >98 degrees F, Humidity <20%, Wind >15 m.p.h. Edible berries would not be treated with herbicide. Herbicide application would be suspended if rainfall is heavy enough to cause movement of herbicide from target species. No herbicide would be applied within 50 horizontal feet of perennial or intermittent springs and streams or within 30 horizontal feet of lakes.

The environmental analysis considered the effects of herbicide application on human, wildlife and aquatic populations. The Forest Plan, Forest-Wide Standard FW21 (RLRMP pages 3-4) requires that herbicides be applied at a level that minimizes the risk to human or wildlife/aquatic health. The USDA Forest Service contracted Syracuse Environmental Research Associates (SERA), to assess human health effects and ecological effects in the development of environmental consequences of the use of various chemicals in Forest Service programs (Durkin 2007). This analysis used *Human Health and Ecological Risk Assessment Final Report* prepared for the Forest Service by Syracuse Environmental Research Associates, Inc. (SERA 2003a). The analysis is documented in the Project File (USDA 2014b).

The direct spray and consumption of contaminated vegetation hazards would be mitigated by signing the treated area. The accidental spill hazard to fish, algae, and aquatic macrophytes, and consumption of contaminated water would be mitigated by the following:

a.) No herbicide application would occur within 50 feet of any perennial or intermittent stream. All other herbicide application will follow label instructions for use near streams and other bodies of water.
b.) Applicators would carry a spill contingency kit to prevent the spread of an accidental spill.
c.) Label directions would be followed, which includes no applications during rain events or within 24 hours of any rain event.

Herbicide use as proposed in the Proposed Action would be applied at the lowest effective rate in meeting project objectives. All label instructions and RLRMP standards and guidelines would be followed. Forest wide standards and site specific analysis would minimize potential herbicide effects to bat species.

Heritage Resources

Protection Measures for Historic Properties - Action Alternative
The following measures only apply to cultural resource sites that are unevaluated, eligible for listing, or listed in the National Register of Historic Places.

Site Avoidance
Mitigation measures include establishing clearly defined site boundaries and buffers around archeological sites where fuels treatment activities might affect sites and routing any newly constructed fireline away from historic properties. Buffers would be of sufficient size to ensure that site integrity is not compromised.

Site Protection during project implementation
Historic properties located along existing non-maintained roads used as fire lines would be protected by hand-clearing those sections that cross the sites. Although these roads are generally cleared of combustible debris using a small dozer, those sections crossing archeological sites would be cleared using leaf blowers and/or leaf rakes. There would be neither removal of soil, nor disturbance below the ground surface, during fireline preparation. Historic properties and features located along proposed routes of mechanically-constructed firelines, where firelines do not now exist, would be avoided by routing fireline construction around historic properties. Sites that lie along previously constructed dozer lines from past burns (where the firelines would be used again) would be protected during future burns by hand clearing sections of line that cross the site, rather than re-clearing using heavy equipment. Where these activities would take place outside stands not already surveyed, cultural resource surveys and consultation

would be completed prior to project implementation. Protection measures would be applied prior to project implementation to protect historic properties.

(1) *Burn Unit Interior.* Combustible elements at historic properties in burn unit interiors would be protected from damage during burns by removing excessive fuels from the feature vicinity and, where applicable, by burning out around the feature prior to igniting the main burn and creating a fuel-free zone. Historic properties containing above ground, non-combustible cultural features and exposed artifacts would be protected by removing fuel concentrations dense enough to significantly alter the characteristics of those cultural resources. For sites that have been previously burned or that do not contain combustible elements or other above-ground features and exposed artifacts, no additional measures are proposed. Past research indicates that prescribed burning would not be sufficiently intense to cause adverse effects to these features.
(2) *Post-Burn Monitoring.* Post-burn monitoring may be conducted at selected sites to assess actual and indirect effects of the burns on the sites against the expected effects. Arkansas State Historic Preservation Office (SHPO) consultation would be carried out with respect to necessary mitigation for any sites that may incur unexpected damage during or following the burn.

Other Protection Measures

If it is not feasible or desirable to avoid an historic property that may be affected by the proposed action then the following steps would be taken:

(1) In consultation with the Arkansas SHPO, the site(s) would be evaluated against the National Register of Historic Places (NRHP) significance criteria (36 CFR 60.4) to determine eligibility for the NRHP. The evaluation may require subsurface site testing;
(2) In consultation with the Arkansas SHPO, relevant federally-recognized Tribes, and, if required, with the Advisory Council on Historic Preservation (ACHP), mitigation measures would be developed to minimize potentially negative effects on sites The agreed-upon mitigation measures would be implemented prior to initiation of activities having the potential to affect the site.

Discovery of Cultural Resources during Project Implementation

Although cultural resources surveys were designed to locate all NRHP eligible archeological sites and components, these may go undetected for a variety of reasons. Should unrecorded cultural resources be discovered, activities that may be affecting that resource would halt immediately; the resource would be evaluated by an archaeologist, and consultation would be initiated with the SHPO, tribes and nations, and the ACHP, to determine appropriate actions for protecting the resource and mitigating potentially negative effects. Project activities at that locale would not resume until the resource is adequately protected and until agreed-upon mitigation measures are implemented with SHPO approval.

2.4 MONITORING

All activities would be monitored to ensure mitigation measures are applied. Applicable RLRMP monitoring and evaluation requirements would be implemented as directed within budgetary limitations. These requirements include measures to monitor current and past activities in terms of implementation, effectiveness, and validation monitoring levels.

Fire effects are monitored by the Burn Boss and/or Firing Boss during the prescribed burning operations. They determine if the firing pattern should be changed to meet management objectives. This monitoring is performed throughout the firing and through the smoldering phase of the prescribed burn. In addition, periodic monitoring of both dormant and growing season burns would be randomly done by resource specialists to determine the degree and extent of adverse effects. Post-burn monitoring and evaluation is completed one to three days later and compares treatment results with burn plan objectives and mitigation measures. This post-burn monitoring evaluates how much litter and understory vegetation was consumed, the amount of scorch in trees, and adverse effects to other resources. Firelines would be monitored periodically to ensure they are rehabilitated and blocked.

Post burn monitoring would also be used to determine the amount of bare soil exposed and the amount of duff layer remaining. Monitoring may determine the need to take corrective action to reduce adverse effects. Recommendations may also include delaying the next burn or to switch from a growing season to a dormant season burn cycle.

The effectiveness of BMPs and other measures would be monitored to ensure compliance with the Forest Plan, the Clean Air and Clean Water Acts. The monitoring program would measure the success of BMPs and help improve future mitigation methods. The monitoring program would also identify unforeseen problems that require remedial measures. This monitoring would involve field measurements and inspections.

3.0 AFFECTED ENVIRONMENT AND ENVIRONMENTAL CONSEQUENCES

The analysis in this document tiers to the Final Environmental Impact Statement (FEIS) for the Revised Land and Resource Management Plan for the Ozark-St. Francis National Forests. This section discloses the effects of each alternative and forms the scientific basis for comparing the alternatives in Chapter 1. Effects can be positive or negative depending on the resource perspective and desired future condition. Effects can also be direct, indirect, or cumulative. Direct effects occur at the same time and place as the actions that cause them. The causes are usually obvious. Indirect effects occur at a later time or a different place than the actions that cause them. Their causes are not obvious and may stem from effects on other environmental elements. Cumulative effects are the combined effects of these actions with those of other past, present and future actions. Cumulative effects can be on-site (confined to the project area) or off-site (outside the project area). Effects on vegetation, cultural resources or soils are chiefly on-site. Effects on water and air quality or wildlife are commonly both on and off-site.

Resource area topics and issues analyzed in detail:

Air Quality
The Federal Clean Air Act stipulates that Federal Agencies have an affirmative responsibility to protect a forest's air quality from adverse air pollution impacts. The Proposed Action could have the potential to noticeably change the air quality of the area or parts of the Forest, for short durations of time. Therefore, impacts to air quality are analyzed in this EA.

Soils and Water Resources
The proposed activities, specifically prescribed burning and fire line construction could contaminate or chemically alter soils in the prescribed burn areas. Therefore, impacts on soils are analyzed in this EA. Prescribed burning and fire line construction, as well as all other ground-disturbing treatments, could adversely affect water resources and water quality as a result of contaminated runoff from the project sites. Therefore, impacts to water resources are analyzed in this EA.

Vegetation
Since the composition and structure of forest communities in the prescribed burn areas could be affected by the proposal, this EA considers the impacts of the Proposed Action and its alternatives on vegetation.

Wildlife, Including Management Indicator Species (MIS) and Proposed, Endangered, Threatened, and Sensitive (PETS) Species
Wildlife, including MIS and PETS could be affected from the proposed activities in the project area. MIS are grouped into three categories:

- Demand species are those species that provide important recreational and/or economic values.
- Species of concern are those species for which there is a concern about their population numbers.
- Ecological indicators are species that are tied to a particular element(s) of biological diversity and serve as surrogates for other species associated with that element(s).

In addition, control of unwanted vegetation could alter habitats for various wildlife species in the area. The Federal Endangered Species Act (ESA) prohibits harm to any species of flora or fauna listed by the U.S. Fish and Wildlife Service (USFWS) as being either threatened or endangered. Such harm includes not only direct injury or mortality, but also disrupting the habitat on which these species depend. Potential impacts to Sensitive Species on the Regional Forester's list are being evaluated will be discussed in the Biological Evaluation (BE) for this project which is still in the process of preparation at this writing.

Human Health and Safety
Workers could be harmed during prescribed burning and fire line construction. In addition, the public could be put at risk from smoke produced by prescribed burning. Therefore, impacts on human health and safety are addressed in this EA.

Heritage Resources
In compliance with NHPA S. 110, a cultural resource review and inventory for the Lee Creek Unit in its entirety was conducted in 2010-2014. The findings of this Unit Assessment are currently being compiled and would be submitted to the Arkansas SHPO and relevant federally recognized Tribes in early 2015. Therefore, any specific impacts on heritage resources will be evaluated in the final version of this EA.

Resource Areas Not Evaluated in Detail

A summary of resource areas and issues considered and dismissed from further analysis in this EA are described below, along with rationale for their dismissal.

Economics
Prescribed burning and associated activities are generally done by trained Forest Service employees with little to no help from contract labor. There are some benefits to the local economy, however, these benefits have no measurable impacts and are likely to occur as a result of everyday business. For this reason, the economics of the proposed treatments are not handled in detail in the following analysis.

Transportation
Neither the Proposed Action nor its alternatives have the potential to affect road transportation in or around the Forest. Therefore, this resource area was dismissed from further consideration in this EA.

Utilities
Neither the Proposed Action nor its alternatives would adversely impact above- or below-ground telephone, electrical, natural gas, water, and sewer lines or cables. No change in the demand for local utilities or usage would occur. Therefore, this topic was dismissed from further analysis in this EA.

Environmental Justice
Executive Order 12898, *Federal Actions to Address Environmental Justice in Minority Populations and Low Income Populations*, requires Federal agencies to identify and address any disproportionate adverse human health or environmental effects of projects on minority or low-income populations. According to this Executive Order, each Federal agency must conduct its programs, policies, and activities that substantially affect human health or the environment, in a manner that ensures that such programs, policies, and activities do not have the effect of excluding persons or populations from participation in, denying persons or populations the benefits of, or subjecting persons or populations to discrimination under, such programs, policies, and activities because of their race, color, national origin, or income level. The proposed project is located within the boundaries of a National Forest, and thus, would not cause any displacement of any residents, nor would it eliminate any employment opportunities. Neither the Proposed Action nor its alternatives are expected to result in any changes in the socioeconomic environment in or around the project area. While the Proposed Action may result in short-term, adverse impacts on human health and safety, these impacts would affect all people, regardless of race or income level. No disproportionate, adverse impacts on minorities or low income populations or communities would result from the Proposed Action or its alternatives. In addition, no long-term health or safety impacts would result from the project, and no specific risks to the health or safety of children are anticipated.

3.1 AIR QUALITY

Air quality is recognized in the RLRMP for the Ozark-St. Francis National Forests as an important parameter to measure forest health.

The RLRMP requires that the Forests work to:

- prevent degradation of air quality from prescribed fire activity and other Forest actions;
- plan for resource management emissions to fall within the current state implementation plan (SIP), which establishes acceptable levels of air pollution.
- minimize air pollution impacts to the Air Quality Related Values (AQRVs) of the Upper Buffalo Wilderness: an area designated for the most stringent degree of protection from future degradation of air quality.

Air pollution has potentially negative effects on the environment including human health. The two main air pollutants of concern within the vicinity of the Ozark-St.

Francis National Forests are ozone and fine particulate matter. At elevated ambient concentrations, ground level ozone can cause respiratory distress in sensitive persons and can retard vegetation growth. Fine particulate matter ($PM_{2.5}$) causes cardiopulmonary symptoms in certain individuals and is the leading cause of regional haze (visibility impairment). The U.S. Environmental Protection Agency (EPA) has established National Ambient Air Quality Standards (NAAQS) for these pollutants as well as four others considered harmful to public health and the environment (http://www.epa.gov/air/criteria.html). The standards were set at the level required to provide an ample margin of safety to protect the public health.

State air quality agencies monitor ozone and $PM_{2.5}$ near the Ozark-St. Francis National Forests. Measured concentrations are compared to the NAAQS for each pollutant. Areas that exceed the NAAQS are designated nonattainment, and a State Implementation Plan (SIP) must be prepared to demonstrate how the area will come back into attainment with the NAAQS.

Additionally, air quality agencies issue an air quality forecast in the form of the Air Quality Index (AQI) for the pollutants. The AQI is color coded as illustrated in the following table. An AQI of code orange, red, purple, or maroon indicates that air quality in the area is predicted to exceed the NAAQS.

Table 2. Air Quality Index (AQI) for pollutants

AQI Code	*Description*
Green	Good
Yellow	Moderate
Orange	Unhealthy for Sensitive People
Red	Unhealthy
Purple	Very Unhealthy
Maroon	Hazardous

The Forest Plan has the following forest-wide standards relating to air quality.

- FW93: Prescribed burning will be conducted in, or adjacent to, counties with forecasted high Air Quality Index (AQI) values only if meteorological conditions indicate that smoke will be carried away from the high AQI area.
- FW94: Conduct all National Forest management activities in a manner that does not result in (1) a significant contribution to a violation of National Ambient Air Quality Standards (NAAQS) or (2) a violation of the applicable provisions in the State Implementation Plan (SIP).

Existing Conditions
The Clean Air Act and its amendments designate specific wilderness areas and national parks as mandatory Class I areas which are to be afforded special protection against degradation of air quality related values such as visibility. The Clean Air Act requires federal land managers with the 'affirmative responsibility' to protect the air quality related values within Class I areas, and to consider whether a proposed new or modified source of air pollution may adversely impact these values. Areas designated as Class I areas are "*designated for the most stringent degree of protection from future degradation of air quality*." The closest Class I areas to the project area are Caney Creek Wilderness area to the south and the Upper Buffalo Wilderness (managed by the Forest Service) to the northeast.

The entire project area lies within lands designated as a Class II area with respect to the air resource. The Clean Air Act defines a Class II area as "*A geographic area designated for a moderate degree of protection from future degradation of the air quality*." Existing emission sources occurring within the project area consist mainly of mobile sources. These include, but are not limited to, combustion engines, dust from unpaved surfaces, and smoke from prescribed (federal, local, county) burning.

Effects from the proposed action alternative

Direct and indirect effects
Prescribed fire emits particulate matter ($PM_{2.5}$), along with pollutants such as carbon monoxide and nitrogen oxides. The major local effects of prescribed burning are visibility reduction and respiratory impairment near the fire. The planned prescribed burning would increase particulate matter in the air thus reducing atmospheric visibility. It would also reduce air quality by emitting carbon monoxide and hydrocarbons but would not violate air quality standards.

Fire managers are aware of downwind concentrations of fine particulate matter and work to ensure that prescribed fire emissions are not contributing to any violations of the National Ambient Air Quality Standards (NAAQS). These are based on three year averages of the measured concentrations. Monitors have not documented any exceedances of the $PM_{2.5}$ or ozone from 2006 through 2010. Even with the addition of prescribed fire contributions, the concentrations of fine particulate matter, both on a daily and an annual basis are not higher than the $PM_{2.5}$ NAAQS (USDA 2010, EPA 2012).

Off-site of the prescribed burns, none of the emissions would cause the National Ambient Air Quality Standards (NAAQS) to be exceeded, providing state and regional smoke management guidelines are followed. Proper firing techniques and the timing of the prescribed burn would limit the impacts from smoke. These effects on air quality are expected to be brief, intermittent and confined to the time of the burn (VMFEIS, Volume I, Chapter IV, pp. 116-123).

Cumulative effects
The Clean Air Act doesn't require EPA to establish air quality standards for carbon dioxide emissions at this time. Ninety percent of the emissions from forest fires are carbon dioxide and water vapor. (Southern Forestry Smoke Management Guidebook page 12). Carbon dioxide is an odorless and colorless nontoxic gas formed abundantly in nature by the decomposition of organic substances. It is exhaled by all living organisms during breathing and absorbed from the air by plants for use in photosynthesis. Carbon dioxide's only potential as a pollutant is as a contributor to the overall greenhouse effect that is causing a rise in the Earth's air temperatures. Fire has come into scrutiny as a producer of carbon dioxide in light of concern over global climate change. Studies are underway to document in some fuel types how much carbon is emitted during burns, and how long it takes for burned areas to return to equilibrium. Given the scale of this project area the issue of modeling the effects on global climate is considered beyond the scope of this analysis.

The Forests work with state regulatory agencies in Arkansas and Oklahoma to determine if new or existing industry will impact air quality at the Upper Buffalo Wilderness through the Prevention of Significant Deterioration (PSD) permitting process. No permit actions since 2006 have been shown to cause an adverse impact to the Upper Buffalo Wilderness (USDA 2011).

Effects from the no action alternative

Direct and indirect effects
There would be no major changes to present air quality. Exhaust emissions and dust from vehicles passing through the project area would continue. Occasionally, local residents will burn trash and small brush piles which generate smoke. The only potential change would be associated with the increased risk of wildfires. The chance of wildfire increases as more fuels buildup occurs. Wildfire releases more pollutants than prescribed fire.

Cumulative effects
Since there would be no direct or indirect effects to air quality, there would be no cumulative effects except possibly in the case of a catastrophic wildfire.

3.2 SOILS AND WATER

This section addresses how the proposed action may compact and displace soils in the project area and how this may affect water quality, stability, erosion, and sedimentation of area streams.

A watershed provides a spatial context into which land management effects can be examined. It can be described as a user-defined point above which all surface water flows. Watersheds are natural divisions of the landscape that include both the waterway and the land that drains to it. Land managers often use Hydrological Unit Codes (HUCs) to describe watersheds and their relationships to each other. Hydrologic units are drainage areas that are delineated so as to nest into a multi-level hierarchical drainage system. The more digits that are in a hydrologic unit, the smaller the unit. There are six levels in the hierarchy, represented by hydrologic unit codes from 2 to 12 digits long, called regions (2 digits) , subregions (4 digits) , basins (6 digits) , subbasins (8 digits) , watersheds (10 digits) , and subwatersheds (12 digits). The Forest Service typically analyzes effects to watershed resources at the subwatershed level.

Existing Conditions

Most of the Lee Creek Unit is within the Kerr Reservoir subbasin (Cove and Webber watersheds). A small portion in the northwest corner of the unit is in the Illinois River subbasin (Barron Fork watershed) and another small part in the southeast is in the Frog-Mulberry subbasin (Frog Bayou and Upper Frog Bayou watersheds).

Designated uses are determined by the Arkansas Pollution Control and Ecology Commission Regulation 2 – Water Quality Standards for Surface Water (2014). In the Kerr Reservoir subbasin beneficial uses include primary contact recreation and perennial designated fishery. The Cove Creek watershed is a part of a municipal drinking supply for the City of Fort Smith and surrounding areas such as Cedarville. The area is popular with swimmers and floaters as well as anglers. Beneficial uses include secondary contact recreation, domestic, industrial, and agricultural water supply and seasonal designated fisheries.

There are twelve subwatersheds making up approximately 399 square miles of land associated with the project area (figure 3). The subwatersheds with percentage of potential burn area activities are shown in table 3. The subwatersheds which have potential to be affected by Forest Service activities upstream include Fall Creek (downstream of Lee Creek Headwaters and Blackburn Creeks), Elmo (downstream of Cove and Fall Creeks), East Cedar (downstream of West Cedar Creek) and Missing Branch (downstream of Elmo and Mountain Fork Creeks). The subwatersheds which are headwaters and would not have any potential to be influenced by upstream Forest Service activities are: Mountain Fork, Webber Branch, West Cedar, Clear, Blackburn, Lee Creek Headwaters, and Cove Creeks. The Forest Service uses a science-based approach to identify the condition of the subwatersheds that they manage and protect.

The Watershed Condition Framework (WCF) defines watershed condition and proactively implements restoration in priority watersheds. A document describing this process is available at:
http://www.fs.fed.us/publications/watershed/Watershed_Condition_Framework.pdf .
This process includes a watershed condition classification with three categories: functioning properly, functioning at risk, and impaired function. Functioning properly means that the attributes of the subwatershed are appropriate to maintain or improve biologic integrity, human disturbance has minimal impact on natural processes and the system is resilient to disturbance. Impaired function means that there is some physical, hydrologic, or biological process which threshold has been exceeded relative to the system's natural potential. A functioning at risk rating indicates that there is some deviation from the natural potential of the subwatershed. No subwatersheds associated with the Lee Creek Fuels Treatment Project are categorized as impaired; however, three subwatersheds are functioning at risk: Webber Branch, Upper Evansville and Cove Creek - Lee Creek.

Stream System

The subwatersheds in Arkansas and Oklahoma contain 860 miles of streams. About 157 miles of these are within the potential burn area. Most of the headwater streams are fairly high gradient and well-entrenched and composed of cobble and boulders with well-developed riparian areas. The lower gradient and larger streams such as Cove and the lower reaches of Lee Creek are primarily cobbles, gravels, and sand. Of the 5,990 acres of floodplains, about 2,095 acres are within potential burn areas.

Table 3. Subwatersheds within the Lee Creek Unit

Watershed name	Subwatershed name	Total acres	Acres in Lee Creek Unit	Max acres burn	Max percent burn
Cove-Lee	Mountain Fork	25,379	16,992	11,231	44
Cove-Lee	Cove Creek-Lee Creek	34,715	15,535	12,199	35
Cove-Lee	Elmo Creek-Lee Creek	12,587	12,680	5,046	40
Cove-Lee	Fall Creek-Lee Creek	21,913	9,741	6,483	30
Cove-Lee	Missing Branch-Lee Creek	8,867	8,735	1,488	17
Cove-Lee	Blackburn Creek	19,167	5,818	4,548	24
Cove-Lee	Headwaters Lee Creek	22,017	5,395	4,574	21
Baron Fork-Illinois River	Upper Evansville Creek	16,044	1,064	798	5
Frog Bayou	East Cedar Creek	19,486	2,035	649	3
Frog Bayou	West Cedar Creek	14,030	9,346	5,040	36
Upper Frog Bayou	Clear Creek-Frog Bayou	28,331	3,835	1,716	6
Webber Creek	Webber Branch	21,883	8,840	3,686	17

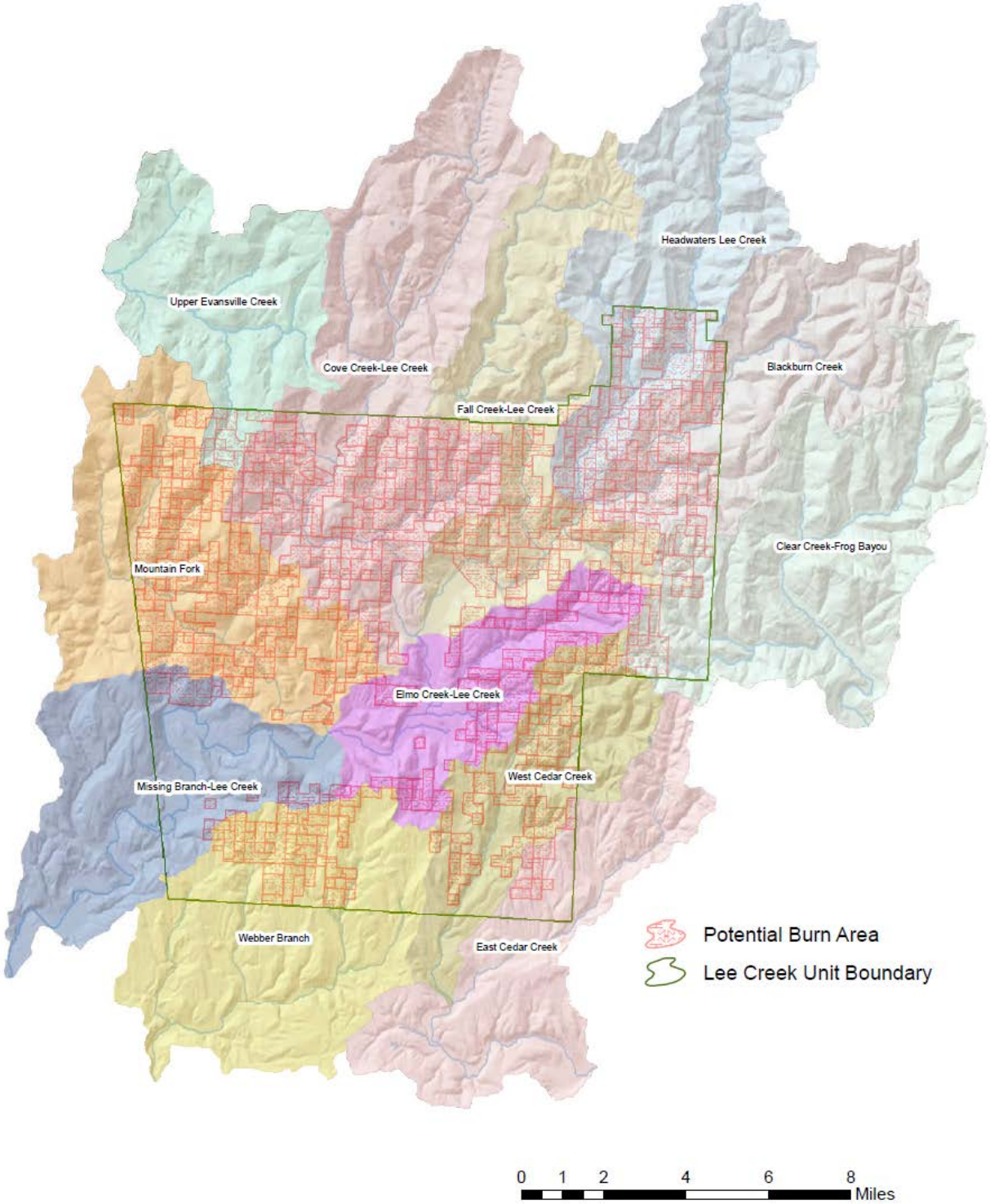

Figure 3. Subwatersheds in vicinity of proposed prescribed burning

Geology, Land Type Associations, and Soils

The subwatersheds are in the Boston Mountains physiographic region of the Ozark Plateau (Interior Highlands). Most of the area is of the Bloyd shale formation with a small swath of Atoka formation. These formations are composed of Pennsylvanian age sandstone and shale. The landtype association is the Mesic Atoka Mountain Uplands: the highest uplands of the Boston Mountains. The rugged land surface form is characterized by moderately dissected uplands with broad ridges and sharply defined narrow valleys. The narrow flat ridges are highly dissected by stream networks. Valley floodplains are narrow with alternating shale slopes and resistant sandstone benches. Most of the soils are well drained and formed in residuum and colluvium from loamy and clayey material that weathered from sandstone and shale. Permeability ranges from very slow in the moderately deep clayey soils on the sideslopes to moderately rapid in the shallow loamy soils on the ridgetops. The sandy loam soils along the streams have moderate fertility. About 65% of the project area is made up of Nella-Enders Association Soils

Effects from the proposed action alternative

Direct and indirect effects -soils

Fire effects on the soils in the project area would be primarily indirect. Prescribed fires enhance nutrient availability for plants by promoting phosphorus cycling and reducing soil acidity. Subsurface heating kills soil dwelling organisms, alters soil structure, destroys organic materials, and promotes leaching at later periods during rainstorm events. The effects of heating on soils depends on intensity and frequency as well as size and arrangement of fuels, fuel moisture content, fuel distribution, rate of combustion, soil texture, soil moisture content and other factors. Prescribed burning as described for this project would remove some but not all organic material. Best management practices (BMPs) which include burning when soil moisture content is higher would help reduce these possible indirect effects.

Most of the soils in which fire lines exist or would be created would be unsaturated and rocky – avoiding two features that increase compaction vulnerability (saturation and uniform soil texture). Light burns cause negligible erosion because they expose almost no soil. Cool season burns are usually light to moderate in intensity, so their effect on erosion is generally negligible. The effects of prescribed fire on soil and water are further discussed in the VMEIS, volume 1, pp. IV-85 to IV-91 (USDA 1989).

Where feasible, agreements with private landowners would allow burns to be across private lands, thereby making manmade and natural fire barriers more accessible and decreasing the need for fireline construction. Minimum disturbance fire control line (utilizing handtools) would serve to reduce soil disturbance as well. Areas burned quickly revegetate with grass, sprouts, and forbs.

Mechanical fuels treatments rearrange fuels vertically by adding them to the forest floor. Depending on conditions such as slope, aspect, soil, weather and vegetation type, these fuels may burn more easily with a lower risk of crown fires. However, more densely

packed fuels may also increase soil temperatures (Kane et al 2009). This may be mitigated by choosing conditions where soils have more moisture such as after a rain event before prescribed burning areas which have been previously masticated (Busse *et al*. 2010).

Herbicide applications to control competing vegetation do not disturb the nutrient rich topsoil layer, do not create additional bare soil, and do not adversely affect watershed condition when used according to Forest Service guidelines. By utilizing herbicides, the organic matter is left in place and off-site soil movement does not increase the loss of nutrients following harvest activities compared to the other types of management practices.

Cumulative effects - soils

Within the past ten years only portions of Blackburn Creek, Headwaters Lee, and Mountain Fork subwatersheds have been prescribed burned. Some patches of commercial thinning have occurred in the past ten years in the Elmo, West Cedar, and East Cedar subwatersheds. Monitoring before and after these prescribed burns have detected no harmful effects on soils and water resources.

The order of entry scheduled within the next 10 years includes three projects distributed among the subwatersheds of the Lee Creek Unit (Table 4).

Table 4. Future Projects in the subwatersheds of the Lee Creek Unit.

Subwatershed	**acres**	**Percent of subwatershed**
Blackburn Creek	5,784	30
Clear Creek-Frog Bayou	3,804	13
Cove Creek-Lee Creek	15,549	45
East Cedar Creek	2,004	10
Elmo Creek-Lee Creek	10,848	86
Fall Creek-Lee Creek	9,762	45
Headwaters Lee Creek	5,414	25
Missing Branch-Lee Creek	2,585	29
Mountain Fork	16,759	66
Upper Evansville Creek	1,070	7
Webber Branch	7,485	34
West Cedar Creek	9,312	66

The figure for acres represents the total area where all possible activities may take place and not the total acres of all possible activities which would be much smaller. Elmo Creek, Mountain Fork, and West Cedar are the subwatersheds with the largest proportion of area planned for future projects. It is not possible at this time to predict the cumulative effects of these future projects on these subwatersheds since the prescriptions for the areas have not been completed.

Direct and indirect effects - water

Effects to water quality are dependent on the size, intensity and the severity of fire, watershed condition, and the intensity, duration and total amount of rainfall. Primary concerns for changes in water quality from fire are increases in sediment entering waterways from accelerated erosion and increased nutrients from sediment and ash entering waterways. Increases in storm flows beyond the capacity of the stream system to handle the excess water are also a concern. Under prescribed burning conditions and site conditions it is possible to select appropriate weather conditions prior to burning to minimize the effects of fire on consumption of organic matter. Since much of this organic material remains intact interception rates remain at high levels and so increases in stormflows due to prescribed burns are uncommon.

Due to the production of ash, temporary increases in suspended solids and dissolved salts in local streams are likely to result from runoff producing precipitation events immediately following a controlled burn. The City of Fort Smith has expressed concern over this and the Forest Service agrees that water quality is an important factor to consider in these subwatersheds, particularly for Cove-Lee Creek, categorized as impaired by the Watershed Condition Class system. As much as 35% of the area has the potential to be burned throughout the life of this project. Research on suspended solids in stream systems after prescribed burns suggests that there is very little influence of fire on nutrient regimes and where differences exist with streams in unburned areas; they usually do not persist more than one to three years (Bayley and others 1992).

In general, prescribed fire and other fuels management approaches appear to have little impact on water quality in eastern North America. When soils are deep and fire severity is low, few water quality changes have been observed, and those that have been reported are generally short lived (less than one year). The most dramatic impacts have occurred where soils are shallow and fires are severe: in these situations, some water quality parameters remained elevated for three or more years (Kolka 2012).

A review of the literature indicates prescribe fire in the east does not appear to alter infiltration or percolation rates or lead to significant increases in surface runoff and infiltration rate (Elliot and Vose 2005, Knighton 1977).

The potential for soil erosion would be greatest during fireline construction or use of mechanical fuels treatment equipment. Physical barriers such as silt fences, straw bales, or waterbars would be placed as necessary to eliminate surface runoff into stream channels. Sites would be monitored after storms until new vegetation is established, to

assure sediment would not enter stream channels. Small areas in moderately rugged terrain subjected to prescribed fire would have little if any effects on water resources if BMPs are utilized.

Hand constructed firelines are typically used on steeper slopes and in sensitive locations including riparian areas when needed and per the RLRMP standards. They cause less impact to the soils and vegetation when compared to dozer firelines. Manual constructed firelines are usually no wider than 18 inches to bare soil with additional vegetation clearing on either side of the line. Sometimes leaf blowers and wet line are sufficient to establish control lines in these areas depending on conditions.

Chemicals from herbicides can enter streams through direct application, drift, mobilization of residues in water, overland flow, and leaching. The most significant transport pathway would be direct application, drift, and mobilization during periods of heavy precipitation and overland flow. The most effective means for reducing this possible outcome is to maintain a buffer between the area for use and waterbodies, and to plan appropriately for application time frames.

Herbicide use in this alternative would be applied by direct injection, cut surface, or foliar spray. Herbicide use within these subwatersheds is infrequent and direct application methods would minimize off-site movement. Forest-wide standards for herbicide application would be followed as well as appropriate BMPs designed to limit risk to water quality.

Cumulative effects - water

Past and present water quality problems especially within Lee Creek and its tributaries have been exacerbated by shallow soils, locally steep gradients, and thin duff layers which cause excessive runoff and not enough percolation of water into the ground. The Buckhorn Trails system is in the project area and the sustained use of both legal and illegal trail has caused alterations in surface flows.

The prudent use of prescribed fire with the mitigations from BMPs and other Forest guidelines would result in minimal surface disturbance and erosion within the subwatersheds of the Lee Creek Unit and would help avoid impacts from large, intense wildfires. As discussed under cumulative effects of soils resources, past projects when combined with current proposed activities would have no negative effects on water quality. It is not possible to determine effects from future activities at this time.

The Ozark-St. Francis National Forests utilize standards for herbicide application which require buffers between treated vegetation and waterbodies, as well as standards to ensure that drift and direct application to waterbodies does not occur. This alternative includes the use of BMP practices and monitoring to ensure environmental quality is maintained. Monitoring after herbicide use on the Ozark National Forest over the last ten years has not documented any considerable concentrations of herbicides off-site from their application.

Effects from the no action alternative

Direct and indirect effects - soils

There would be no short term increases in sediment transported within stream chanels associated with line-prep and other prescribed fire management activities in this alternative. Current management of the area would continue as it has in the past with no immediate changes to soils. This alternative would not cause any long-term negative effects on the analysis area except in the case of random fire events caused by increased fuel loads, drought, and/or arson. Wildfires in this area may cause more damage to water and soil resources than would wildfires in areas with regular prescribed burning.

Cumulative effects - soils

The project area has many areas of increased fuels loads which increases vulnerability of these areas to severe wildfires. Over time with the buildup of fuels in vulnerable areas wildfires may negatively affect soils by increasing the potential for vegetation loss and increased runoff, especially in areas with high slopes such as reaches and small tributaries within the Cove Creek, and Falls Creek subwatersheds. Severe wildfires which expose bare soil compromises infiltration resulting in a collapse of soil structure with increase in soil bulk density, reduced soil porosity which indirectly results in increased surface runoff, impact from rain drops displacing soil and ash clogging soil pores.

Direct and indirect effects - water

Current management of the area would continue as it has in the past with no immediate changes to water resources. This alternative would not cause any long-term negative effects on the analysis area except in the case of random fire events caused by increased fuel loads, drought, and/or arson.

Cumulative effects - water

In the absence of wildfires, watershed conditions would remain the same aside from naturally occurring erosion and sediment runoff to streams. Due to the increased vulnerability of the area to catastrophic widlfires, the no action alternative may have negative cumulative effects on water resoures. Large wildfires would have more potential to burn larger areas of subwatersheds which would lead to increased potential for floods and debris flows, particularly in areas with steep slopes.

Effects to the water resource from fuel build up and the potential for severe wildfire would have longer lasting effects compared to managing fuels through prescribed burning. The more severe the fire , the greater the amount of fuels consumed with associated release of nutrients, loss of shading effect, soil erosion and subsequent sediment, and overall changes to the watershed condition.

3.3 VEGETATION

Existing Conditions

Most of the subwatersheds associated with the project are over 80% forested. Historically, the landscape containing the project area consisted of fire-dependent woodland and forest ecosystems with well-developed herbaceous understories. These included open hardwood and pine/hardwood woodlands with open overstory canopy, sparse midstory and a well-developed grass and herbaceous understory. On appropriate sites, savannahs were present and glades were more numerous and extensive.

The project area was historically subject to a more frequent fire regime, both natural and man-made. Mean fire return interval for the period of 1680-1820 ranged from 4.6 to 16 years, for the period of 1821-1880 ranged from 2 to 3.1 years and for the period of 1881-1920 ranged from 1.4 to 5 years. From 1921-2000 mean fire return interval for these study sites ranged from 62-80 years (Guyette and Spetich 2003).

Past and current timber harvesting, land clearing, and farming have created disturbed patches across the landscape creating fragmentation. Many small farms were settled along flood plains and flat ridges in the middle 1800s through early 1900s. Beginning in the early 1900s, the area was extensively harvested for timber. The Forest Service began acquiring these lands in the 1920s when many farms were abandoned during the great depression. Much of these acquired lands were planted with shortleaf and loblolly pine by the 1950s as well as with non-native fescue for forage production and serecea lespedizea for erosion control and wildlife forage.

Over the past 50-70 years, wildfires have been excluded from the project area due to an aggressive fire suppression program. The influence of fire suppression has contributed to encroachment by eastern red cedar, pine, and hardwood species in glade habitats; fundamentally altering the function of these special habitats. It has allowed shade tolerant and fire intolerant tree species such as red maple and elm to become more common in the midstory and understory, and out competing fire-adapted oaks and hickories.

Existing ecological conditions in the project area include dense, overstocked stands, a shift from the historic plant community composition toward fire intolerant plant species in former woodlands, lack of herbaceous species diversity, and prevalence of introduced/noxious cool and warm season grasses.

North facing slopes in the Lee Unit are typically moist and include northern red oak, white oak and hickories. Midstories in these communities are less diverse than similar sites on the main division (USDA 1992). South facing slopes are typically composed of drier communities with post and blackjack oak predomiunating often along with a cedar component. Riparian communities along Mountain Fork and Cove creeks have been much reduced due to land clearing during settlement.

The majority of stands within the Lee Creek Unit have closed canopies and are over mature (>70 yrs.) with many dead and or dying trees either from insects, diseases, or oak decline events. Advanced regeneration is sporadic in places where overstory mortality has occurred but is being suppressed by fire intolerant/shade tolerant species already existing in the midstory. Very little vegetation (forbs, grasses, etc.) exist in the understory that are optimal for various wildlife species for browse due to the closed canopy conditions.

Most of the pine stands in the Lee Creek Unit have similar site indices but average much higher basal areas in a range of 100 up to 160 or more. The majority of these stands will be thinned in the next 3-6 years under the Bundle Pine project. Most of these stands exist in old fields once farmed by the early settlers and were re-vegetated once ownership was acquired by the Forest Service. Most of these stands are extremely overstocked with closed canopies creating a biological desert in the mid and understory with no browse or hard mast for wildlife. Non-native loblolly pine dominates in some of these stands.

Effects from the proposed action alternative

Direct and indirect effects

Prescribed burning would reduce accumulations of hazardous fuels, encourage advanced oak regeneration, encourage natural regeneration of pine, reduce shade tolerant (fire intolerant) woody species, and assist in thinning stands to more sustainable levels of tree stocking. Understory vegetation diversity would be promoted which would increase wildlife foraging and habitat availability. The risks inherent to prescribed burning include but are not limited to tree scorch on pine and hardwood trees, tree mortality, and minor loss of timber grade in hardwoods. During drought years, there is increased stress on trees and prescribed fire may increase the number of trees that die. The risks involved to vegetation would be minimized with prescribed burn plans in place that define burning parameters in regards to weather and drought indices.

Frequent prescribed burning is necessary to restore and maintain open woodland communities. Prescribed fire would benefit fire-adapted species, including shortleaf and longleaf pine and associates, and warm season grasses. Planned harvest activities under the Bundle Pine Project followed by frequent short rotation prescribed burning would promote more open conditions in the understory and would tend to favor pine, oak, and hickory species over less fire-intolerant species such as maple, sweetgum, and elm. Native grasses and forbs would become more dominant in the understory. Landscape burning would result in a mosaic of unburned and burned areas across the landscape.

In areas where mechanical fuels treatment is used in addition to prescribed burning, residual trees may be more protected from possible mortality due to crown fires.

Cumulative effects
Prescribed burning would help to maintain early successional habitat conditions longer and add to habitat diversity by altering vegetation composition, structure, and function. The mosaic and shifting pattern of burning would help to create a variety of vegetation conditions across the landscape. This would allow for maximum crown and root development needed to increase tree health and would help in reducing insect and disease damage by keeping stands open longer and breaking up the continuity of vegetation that has allowed large scale insect infestations in the past.

The Boston Mountain Ranger District is working to restore upland hardwood woodland communities where prescribed fire is an essential part of the equation to restoring these unique ecosystems. Midstory treatments along with prescribed burning have been used in the past to reduce hazardous fuels, restore fire adapted ecosystems, and to improve wildlife habitat. Vegetation impacts would primarily occur to understory and midstory vegetation. There would be a mosaic of burned and unburned areas. Burning would maintain open conditions and native grasses and shrubs would be evident in stands that have had previous timber harvest. This would add to habitat diversity, even though the existing overstory types would likely not change. The proposed action, in conjunction with ongoing projects and plans, would cumulatively benefit vegetation diversity and forest health.

Effects from the no action alternative

Direct and indirect effects
No action for the proposed project area would result in a continued progression of overstocked trees within the stands. Available resources needed for the trees to grow would begin to become less available for individual trees and eventually mortality from competition would begin with suppressed trees. Growth among the surviving trees would stagnate because of the lack of space and the lack of resources needed to continue growth. The trees would become stressed and the chances of becoming susceptible to diseases and insect attacks would increase. The closed canopy would persist with limited light being able to penetrate the forest canopy and reach the forest floor. This would result in a loss of understory growth, thus reducing the herbaceous vegetation available to wildlife.

Without prescribed burning, changes to understory development would be limited to that produced through timber harvest alone (harvest under the Bundle Pine Project is expected to begin in 2015) and on a more limited scale, through selective herbicide application allowed through other decisions. Understory development would be limited primarily to woody plants, such as sweetgum, red maple, blackberry, and dogwood. Only small increases in grasses and legumes would occur, most often near roadsides or in natural canopy gaps.

With absence of chemical treatments, the incidence of non-native invasive plant species would continue to increase across the landscape, with the exception of areas where specific treatments are addressed through other existing decisions.

Cumulative effects

Without prescribed fire, stands generally succeed to stands dominated by shade-tolerant species. Fire tolerant hardwood species such as oak and hickory would slowly be replaced by more shade tolerant and fire intolerant species such as red maple and beech. Herbaceous understories would become uncommon, and the forest would become dense in the absence of prescribed fire. Fire-adapted plants and communities would decline in quantity and quality. The general health of forest stands may gradually decline in the absence of prescribed burning. There would be an increased risk for wildfire as the understory developed into a midstory creating ladder fuels that would carry fire into the crowns of overstory trees. Higher intensity fires are more damaging to hardwood species and they actually restrict further natural development of the hardwood habitat.

3.4 WILDLIFE

Terrestrial Management Indicator Species (MIS):

A MIS Report on population data including population trends was completed in 2001 for the Ozark-St. Francis National Forests. Seventeen species were selected as MIS for the Ozark National Forest from the Planning Team's review of the list of vertebrate species dependent upon forest habitats (LRMP 2005). Owen (2010) was also used in the evaluation of MIS for this project. These documents are part of the analysis file for analysis of effects to MIS species associated with implementation of project alternatives.

The following table shows Ozark National Forest MIS species pertinent to the analysis area, the habitat type they represent and population trends (USDA 2001 and NatureServe 2010). From the Forest MIS list, 13 species have potential habitat based on occurrence records and/or habitat requirements within the analysis area.

Table 5. MIS Species, Habitat Requirements and Population Trends

Species	MIS Type	Habitat Requirements	Population Trend
Northern bobwhite	ecological indicator	pine and oak woodland and native grasslands	decreasing
Whitetail deer	demand	mosaic of forest age classes	increasing
Black bear	demand	remote habitat with mature forest component with intermixed 0-5 year old regeneration	increasing
Wild turkey	demand	mature forest with open areas containing grasses/forbs/soft mast	decreasing
Prairie warbler	ecological indicator	regenerating forest communities	decreasing
Cerulean warbler	ecological indicator	communities associated with mature hardwood forest with complex canopy structures, and dry-mesic oak forest communities	decreasing range-wide, apparently secure in AR
Northern parula	ecological indicator	communities associated with forests in riparian areas	stable
Ovenbird	ecological indicator	dry-mesic oak forests	stable to increasing
Red-headed woodpecker	ecological indicator	oak woodland overstories	decreasing
Pileated woodpecker	ecological indicator	large snags	stable
Scarlet tanager	ecological indicator	mature dry-mesic oak forest communities	stable
Smallmouth bass	demand	cool water stream communities	stable
Largemouth bass	demand	lake and large river communities	stable

Terrestrial Management Indicator Species 1- Northern Bobwhite Quail

Historically, quail thrived on lands that are now part of the Ozark National Forest due to the significant amount of oak savanna, oak woodland, and glade habitat that was maintained by periodic fire. As farms failed and fire prevention became the norm, a much thicker forest replaced those once maintained by fire or grazing. Although this species is widespread throughout Arkansas, population numbers are very low. During the last decade the population has continued a steady decline (Fowler 1992). Limiting factors listed by the AGFC include the overuse of cool-season forages (bermuda, fescue) and

monoculture hay pastures, the lack of prescribed fire, and timber management practices that do not consider quality quail habitat (AGFC, Quail Management Plan). Very few coveys have been documented in the analysis area.

Effects from proposed action alternative

It is difficult to anticipate how much new or improved early seral habitat would be created as a result of the proposed actions. A good estimate would be approximately 2,000 acres annually due to prescribed burning and/or mechanical fuels treatment. When combined with previous and ongoing projects that include timber treatments, such as thinning, the habitat for this bird would greatly be improved. Herbicide use as proposed in this alternative should not pose any risk to this species as long as label instructions and LRMP guidelines and standards are followed. A discussion on herbicide effects to all the MIS species and wildlife can be viewed at the end of this section. Prescibed fire as called for in this action would maintain the early successional habitat preferred by this species. The implementation of this alternative would greatly improve wildlife habitat and would be beneficial to this bird.

Direct and indirect effects
Direct and indirect effects with this alternative would be beneficial to this species. This species requires open woodlands and grasslands. This alternative would directly improve habitat required by this bird locally.

Cumulative effects
Trends in habitat quality and quantity on nearby private lands are likely to continue. Local (project level) population trends should increase in the short-term (ten years), however, overall bob-white quail populations are expected to remain around current levels with forest-wide management activities combined with actions occuring on private lands.

Effects from no action alternative

Direct and indirect effects
It is expected that the predicted effects from implementation of the no action alternative would be a continued decline in local (i.e., stand level) quail populations. The current conditions include overgrown wildlife openings and pastures and closed canopy pine and hardwood forest. The grass is not spaced out in the mosaic pattern that quail prefer. The no action alternative does nothing to improve habitat for this species. Natural conditions would continue and would not provide the early sucessional habitat that quail need. Direct and indirect effects would be negative to this bird with implementation of this alternative. A lack of active management could cause a local (project area) decline to this species.

Cumulative effects
Cumulatively, trends in habitat quality and quantity on nearby private lands are likely to continue. Local (project level) population trends would likely decrease in the short-term

(ten years) if no action is implemented. Overall bob-white quail populations are expected to remain around current levels with forest-wide management activities combined with actions occurring on private lands.

Terrestrial Management Indicator Species 2- Eastern Wild Turkey

Wild turkeys were abundant on the Ozark National Forest in the mid 1800's. Habitat destruction and unregulated hunting reduced populations to historic lows in the early 1900s. Restocking efforts and habitat improvement have resulted in increasing populations over the last several decades. Wild turkeys occupy a wide range of habitats with diversified habitats providing optimum conditions (Schroeder 1985). Good turkey habitat includes mature stands of mixed-hardwoods, groups of sawtimber-sized conifers, relatively open understories, scattered clearings, well-distributed water, reasonable freedom from disturbance, and adequate area (USFS 1980). During the first few weeks after hatching, turkey poults require large amounts of protein supplied mainly by insects found in grassy openings. These first few weeks are likely the most critical period of the turkeys' entire life (Hewitt 1967). Habitat for the wild turkey in the analysis area is poor due to closed canopy conditions, overgrown pastures and openings and lack of cover in a large part of the area.

Effects from the proposed action alternative

It is difficult to anticipate how much new or improved early seral habitat would be created as a result of the proposed actions. A good estimate would be approximately 2,000 acres annually due to prescribed burning and/or mechanical fuels treatment. When combined with previous and ongoing projects that include timber treatments, such as thinning, the habitat for this bird would greatly be improved. Soft mast vegetation would also be stimulated with the proposed actions. Herbicide use as proposed in this alternative should not pose any risk to this species as long as label instructions and LRMP guidelines and standards are followed. A discussion on herbicide effects to all the MIS species and wildlife can be viewed at the end of this section. Prescibed fire as called for in this action would maintain the preferred early successional habitat preferred by this species. The implementation of this alternative would greatly improve wildlife habitat and would be beneficial to this bird.

Direct and indirect effects

Direct and indirect effects with this alternative would be beneficial to this species. The overall proposed treatments, particularly the different timber/silvicultural treatments combined with prescribed burning would create a mosaic landscape locally that turkeys prefer.

Cumulative effects

Cumulatively, trends in habitat quality and quantity on nearby private lands are likely to continue. Local (project level) population trends should increase in the short-term (ten years), however, overall turkey habitat capability would remain stable with forest-wide management activities combined with actions occurring on private lands.

Effects from no action alternative

It is expected that the predicted effects from implementation of the no action alternative would be little change to local (i.e., stand level) turkey populations. The no action alternative does nothing to improve habitat for this species. Natural conditions would continue and provide unsuitable early successional habitat for the turkey.

Direct and indirect effects
Direct and indirect effects would be negative to this bird with implementation of this alternative. A lack of active management would cause local (project area) declines over time to this species.

Cumulative effects
Cumulatively, trends in habitat quality and quantity on nearby private lands would likely continue. Local (project level) population trends would likely decrease in the short-term (ten years) if no action is implemented. Overall turkey habitat capability is expected to remain stable with forest-wide management activities combined with actions occurring on private lands as well.

Terrestrial Management Indicator Species 3 - White-tailed Deer
White-tailed deer thrived on the Ozark National Forest due to a diversity of habitat types, historic maintenance of deer browse by fire, and the adaptability of this species. Today, deer continue to flourish on the Forest and adapt as habitat and land use changes continue to occur in the area. Deer usually prosper following fire, timber harvest, storms, or other events that produce new vegetation within their feeding range (USFS 1981b). On good sites, forage yields peak at two to three years after regeneration and then decline for the next five or six years. On poor sites, forage production peaks in three to five years and holds up fairly well for ten years or more (USFS 1981b). According to deer spotlight surveys on the Lee Creek Wildlife Management Area (WMA), deer populations have declined over the past ten years.

Effects from proposed action alternative

If this alternative is implemented, it is anticipated that approximately 2,000 acres of improved early seral habitat would be created as a result of proposed actions. The creation and maintenance of wildlife openings and large pastures in additions to the herbaceous flush of forage production on the forest floor following a prescribed burn or mechanical fuels treatment would improve the habitat for deer. Prescibed fire as called for in this action would create some new herbaceous growth for browse. Herbicide use as proposed in this alternative should not pose any risk to this species as long as label instructions and LRMP guidelines and standards are followed. A discussion on herbicide effects to all the MIS species and wildlife can be viewed at the end of this section.

Direct and indirect effects
Direct and indirect effects would be that local deer populations may slightly increase because the new habitat created by this alternative would exhibit a higher amount of available forage (primarily soft mast and browse) than the current existing habitat.

Cumulative effects
Cumulatively, no long-term declines in deer populations would be expected with this alternative combined with both forest-wide and private land management in the area.

Effects from no action alternative

It is expected that the predicted effects from implementation of the no action alternative would be minimal.

Direct and indirect effects
Direct and indirect effects would be that the local (i.e., stand level) population would likely remain stable.

Cumulative effects
Cumulatively, after approximately a ten-year period, there could be a slight decline in the local deer population, however, there should be no effect to the overall population with implementation of the no action alternative when combined with projects on both Forest Service and private lands.

Terrestrial Management Indicator Species 4 - Black Bear
Historically, the black bear thrived in the remote areas of Arkansas (including the Ozark National Forest). Black bears have a preference for large expanses of woodland and forested areas and historically were widely distributed. Today, black bears are largely restricted to more remote, less accessible mountainous areas, nearly impenetrable thickets, and forested areas along watercourses with minimum human disturbance. The distribution of black bears has been largely restricted/influenced by encroaching development and habitat conversion (e.g., agriculture). Early-successional stands provide the high protein foods needed in the post-denning period. Regeneration areas also provide the high-energy food used throughout the breeding season and alternative food sources for fall and winter during years of mast failure. If they are of sufficient size, new stands (five to ten years old) also provide excellent escape cover as well as food.

Effects from proposed action alternative

It is anticipated that approximately 2,000 acres of improved early successional habitat would be created with this alternative at any given time. This type of habitat would provide high protein feeding areas that the bear requires. Prescribed fire in combination with previous and ongoing projects that include varied timber treatments would create a mosaic of habitat preferred by this species. This type of habitat provides the high-protein foods needed after emerging from dens. Burns also increase production of fruits such as

blackberry and low bush blueberry. Herbicide use as proposed in this alternative should not pose any risk to this species as long as label instructions and LRMP guidelines and standards are followed. A discussion on herbicide effects to all the MIS species and wildlife can be viewed at the end of this section.

Direct and indirect effects
Direct and indirect effects to the local (project area) black bear population could be a slight increase in disturbance due to the vegetation treatments. An increase in visitors to the area is anticipated. Local black bear populations and patterns of use may be slightly affected; however, disturbance would likely be short-term. Bears will customarily adjust their patterns to new environments.

Cumulative effects
This alternative would create the early successional habitat that bears prefer. Black bear populations are expected to continue to increase over time. There are no known negative cumulative effects to this species with implementation of the proposed action when combined with actions occurring on both Forest Service and private lands.

Effects from no action alternative

It is expected that the predicted effects from implementation of the no action alternative would have little to no effects on the black bear.

Direct and indirect effects
Direct and indirect effects would be that the local (i.e., stand level) population would likely remain stable. However, this alternative does nothing to create conditions for high-protein food needed for the bear.

Cumulative effects
Cumulatively, there should be no effect to the overall population with implementation of the no-action alternative when combined with projects on both Forest Service and private lands.

Terrestrial Management Indicator Species 5- Pileated Woodpecker
The pileated woodpecker was selected as a MIS to represent snag-dependent species and species requiring older forests. Breeding bird surveys in the Ozark-Ouachita physiographic province suggest that populations of the pileated woodpecker trended downward from the 1960s until the mid-1980s and have stabilized or trended slightly upward since then. Population and habitat trends for this species are dependent on stand age and snag abundance where suitable habitat occurs. This species has remained fairly stable from 1993-2013 on the Boston Mountain Ranger District (figure 4).

Effects from proposed action alternative

Implementation of the proposed action could slighly change this bird's habitat in the pine and hardwood areas slated for prescribed burning if large snag trees were to be destroyed through prescribed burning. The local riparian corridors would also provide habitat for this woodpecker. Prescribed burning would help create additional snags that this bird prefers. Mechanical fuels treatment work is not expected to harm snag trees that this bird may be utilizing. Herbicide use as proposed in this alternative should not pose any risk to this species as long as label instructions and LRMP guidelines and standards are followed.

Direct and indirect effects
Local populations of this species should remain stable to slightly lower the first ten years, but forest-wide population goals should not be affected.

Cumulative effects
Cumulatively, when combined with increased development and stand clearing on nearby private property, a local decrease in suitable habitat may occur.

Effects from no action alternative

Implementation of the no action alternative may have positive long-term effects on the pileated woodpecker as current forest types in the project area continue to age and snag abundance (presumably) increases.

Direct and indirect effects
It is not expected that local populations of this species would experience a decline and forest-wide population goals should not be affected.

Cumulative effects
Cumulatively, when combined with increased development and stand clearing on nearby private property, a local decrease in suitable habitat may occur.

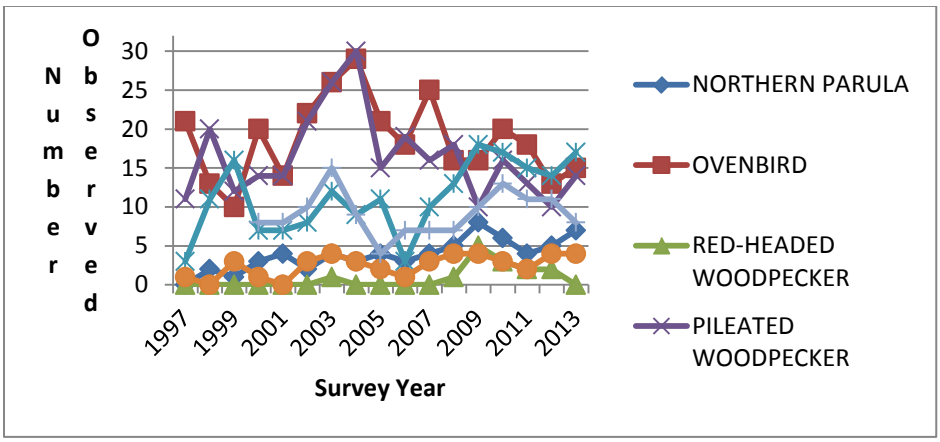

Figure 4. Boston Mountain Ranger District Bird Count Data 1997-2013.

Terrestrial Management Indicator Species 6-Prairie Warbler
The prairie warbler was chosen as a MIS due to its status as a neotropical migratory bird of concern that has specialized habitat needs. Optimal habitat conditions for this species are even-aged regeneration forests of stand size or larger. Monitoring in the Ozark-Ouachita physiographic province shows a declining trend for this species. Prairie warbler numbers on the Boston Mountain Ranger district have slightly increased over the years (figure 4).

Effects from proposed action alternative

There may be a slight negative effect on local prairie warbler populations that are nesting in the area where prescribed burning, mechanical fuels treatment and fireline construction activities occur. Prescribed burning in comibination with ongoing and previous projects, particularly timber thinning could provide a large increase in habitat for this species. Herbicide use as proposed in this alternative should not pose any risk to this species as long as label instructions and LRMP guidelines and standards are followed.

Direct and indirect effects
Direct and indirect effects would be that local populations of this species should remain stable and forest-wide population goals should not be affected.

Cumulative effects
Cumulatively, there would be no known negative effects to this species with implementation of this alternative when combined with actions that occur on public and private lands.

Effects from no action alternative

Direct and indirect effects
This alternative could have a negative direct and indirect effect on local populations as no new habitat is created with this alternative.

Cumulative effects
It is expected that implementation of the no action alternative would have no cumulative effect on the overall populations of this species.

Terrestrial Management Indicator Species 7- Northern Parula
The northern parula prefers mature pine-oak woodlands primarily associated with riparian communities. Nesting preferences for this species include epiphytic growth, lichen growth or moss. When these types of nesting materials are unavailable, other types of nesting material have been used, such as pine needles, box elder blossoms or grass. Numbers for northern parula on the Boston Mountain Ranger District have slightly increased from 1993-2013 (figure 4).

Effects from proposed action alternative

Implementation of this alternative should improve habitat for this bird as it may encourage lichen and epiphytic growth on trees species that it prefers for nesting material. Very few trees would be removed or damaged from the riparian corridors where this bird is generally located. Herbicide use as proposed in this alternative should not pose any risk to this species as long as label instructions and LRMP guidelines and standards are followed.

Direct and indirect effects
Mature riparian habitats (e.g., Lee Creek riparian corridor) would continue to provide desired habitat that this species prefers. Some disturbance to nesting birds is anticipated if this species is present in stands slated for prescribed burning or mechanical fuels treatment. Herbicide use as proposed in this alternative should not pose any risk to this species as long as label instructions and LRMP guidelines and standards are followed. Herbicide would not be used in the riparian corridor. A discussion on herbicide effects to all the MIS species and wildlife can be viewed at the end of this section.

Cumulative effects
Because this species is considered common and because suitable adjacent and nearby habitat is present on both public and private lands, there would be no known cumulative adverse effects to this species with the proposed actions.

Effects from no action alternative

Implementation of this alternative should have some beneficial effects on the northern parula because there would be minimal nesting disturbance with the no-action alternative.

Direct and indirect effects
Mature riparian habitats (e.g., Lee Creek riparian corridor) would continue to provide desired habitat and with no management activities, an increase in mature riparian trees could result over time.

Cumulative effects
Because this species is considered common and because suitable adjacent and nearby habitat is present on both public and private lands, there would be no known cumulative effects to this species with the no action alternative.

Terrestrial Management Indicator Species 8- Scarlet Tanager
The scarlet tanager was selected as a MIS to represent species that require mature interior forest habitat. Breeding bird surveys in the Ozark-Ouachita physiographic province suggest that the scarlet tanager population has been increasing since the surveys began in 1967. This tanager has increased over time as well on the Boston Mountain Ranger District (figure 4).

Effects from proposed action alternative

Implementation of the proposed actions could result in a slight disturbance to nesting birds within the areas slated for prescribed burning or mechanical fuels treatment. Herbicide use as proposed in this alternative should not pose any risk to this species as long as label instructions and RLRMP guidelines and standards are followed.

Direct and indirect effects
Because trails, firelines, pastures and wildlife openings would be maintained in an early seral stage, any scarlet tanagers using the project area near these sites would be forced to relocate to nearby suitable habitat. The management of the analysis area would be expected to continue to provide the mature forest habitat preferred by this species, especially in the riparian corridors and unsuitable/inoperable areas. This alternative could also affect the nesting of this tanager, as it nests 20-25 feet in the canopy. A decrease in local (project level) populations can be anticipated to occur with implementation of the proposed actions.

Cumulative effects
Cumulatively, however, forest-wide population declines are not anticipated because habitat would be maintained in riparian corridors and inoperable areas.

Effects from no action alternative

Direct and indirect effects
Implementation of the no action alternative may have positive long-term effects on the scarlet tanager as current forest types in the project area continue to age and mature. The no action alternative does not propose any new construction, herbicide use or tree removal. This alternative would have beneficial effects to this tanager.

Cumulative effects
Cumulatively, forest-wide population declines are not anticipated with the no action alternative.

Terrestrial Management Indicator Species 9-Ovenbird
The ovenbird is a common species that prefers open, mature, dry, deciduous forest devoid of thick understory. Habitat with an abundance of leaf litter, fallen logs, and rocks are preferred. This species nests on the ground. This species has slowly declined from 1993-2013 on the Boston Mountain Ranger District (figure 4).

Effects from proposed action alternative

Direct and indirect effects
Implementation of the proposed action would result in direct negative effects to nesting birds. The proposed burning and mechanical fuels treatment, however, would create the woodland conditions (devoid of thick understory) that the ovenbird prefers, especially

when combined with other ongoing and future projects that include timber thinning. The overall largescale effect would be an improvement to this bird's habitat, especially for the first three years following treatments. There may be a slight loss of habitat for the ovenbird through clearing of habitat caused by fireline construction. Prescribed burning could benefit this species when conducted outside of the nesting season by removing some of the understory densities, combined with silvicultural treatments such as thinning. Herbicide use as proposed in this alternative should not pose any risk to this species as long as label instructions and RLRMP guidelines and standards are followed.

Cumulative effects
Cumulatively, it is not expected that local populations of this species will experience a decline and forest-wide population goals should not be affected. When combined with increased development and stand clearing on nearby private property, a local increase in suitable habitat may occur.

Effects from no action alternative

Direct and indirect effects
Implementation of the no action alternative could have a negative effect on the ovenbird over time as this alternative does not provide for open woodlands and a forest devoid of thick understory that this bird prefers. Natural conditions would continue and closed canopy conditions would increase over time.

Cumulative effects
Cumulatively, it is not expected that local populations of this species would experience a decline and forest-wide population goals should not be affected. When combined with increased development and stand clearing on nearby private property, a local decrease in suitable habitat may occur.

Terrestrial Management Indicator Species 10-Red-Headed Woodpecker
The red-headed woodpecker is generally uncommon on the Ozark National Forest where it prefers open oak woodlands with savannah-like grasslands and adequate snags to provide nesting and roosting habitat. Documentation of this species has been sporadic over the years on the Boston Mountain Ranger District. Habitat for this species on the Lee Creek unit is poor.

Effects from proposed action alternative

Direct and indirect effects
Implementation of the this alternative would help create some of the open oak woodlands that this woodpecker prefers through prescribed fire, especially combined with current and ongoing timber thinning projects. Prescribed fire would create the snags preferred by this species. There could be a slight loss of habitat for the woodpecker through clearing of habitat caused by fireline construction. Herbicide use as proposed in this alternative should not pose any risk to this species as long as label instructions and LRMP guidelines

and standards are followed. The prescribed burning as proposed in this alternative would provide fair to good habitat for this species. Very little habitat for this species resides on adjacent private lands and it is anticipated that National Forest lands provide better habitat.

Cumulative effects
It is expected that implementation of this alternative would have positive effects to this species, particularly to the analysis area populations.

Effects from no action alternative

Direct and indirect effects
Implementation of the no action alternative could have a negative effect on this bird over time as this alternative does not provide for open woodlands that this species prefers. Natural conditions would continue.

Cumulative effects
It is not expected that local populations of this species would experience a decline and forest-wide population goals should not be affected. Very little habitat for this species resides on adjacent private lands and it is anticipated that National Forest lands provide better habitat. When combined with increased development and stand clearing on nearby private property, a local decrease in suitable habitat may occur.

Terrestrial Management Indicator Species 11-Cerulean Warbler
The cerulean warbler prefers mature and over-mature forest, including bottomland forests and shady upland woods. Preferred habitats generally have complex canopy structure and little undergrowth. This species is locally common and restricted to habitats in the Ozark National Forest, along the Buffalo National River, and various state wildlife management areas. Sightings for this warbler have been rare but steady from 1993-2013 on the Boston Mountain Ranger District (figure 4).

Effects from proposed action alternative

Direct and indirect effects
Implementation of the proposed alternative would result in direct and indirect effects, such as a slight loss of habitat for the cerulean warbler with some of the treatments initially, however, combined with current and future timber treatments such as thinning in mature and immature poletimber stands and WSI treatments would create the complex, un-even aged stand type over time that this species prefers. Prescribed burning and mechanical fuels treatment as proposed would reduce undergrowth that this bird favors. Herbicide use as proposed in this alternative should not pose any risk to this species as long as label instructions and LRMP guidelines and standards are followed.

Cumulative effects
Cumulatively, it is not expected that local populations of this species would experience a decline and forest-wide population goals should not be affected. When combined with increased development and stand clearing on nearby private property, a local decrease in suitable habitat may occur initially, but should increase three to seven years following treatments.

Effects from no action alternative

Direct and indirect effects
Implementation of the no action alternative should have no effect on the cerulean warbler as current forest types in the project area would continue to age and mature. Natural disturbances to the forest would create the complex canopy habitat that this species prefers. The no action alternative does not propose any new construction of roads or tree removal.

Cumulative effects
Forest-wide population declines are not anticipated when combined with activities on private and public lands with this alternative.

Aquatic Management Indicator Species (MIS)

Aquatic Management Indicator Species 1 - Smallmouth Bass
The smallmouth bass is a prized sport fish found in the more pristine rivers of Arkansas. Populations of this species require cool flowing water with deep refuge pools. They are relatively intolerant of siltation. Optimal smallmouth bass habitat includes cool, clear streams greater than 35 feet wide with abundant shade, cover, and deep pools with moderate current and gravel or rubble substrate. It is present at lower elevations in Lee, Elmo and Cove creeks. Currently, the primary concerns for smallmouth bass habitat in the Ozark National Forest are habitat complexity, sedimentation, canopy cover to maintain water temperature regimes, and impacts from roads and trails.

Effects from proposed action alternative

Direct and indirect effects
Effects to this species would be manifested by changes in quality to their large stream habitat (complexity verses simplification) through changes in sediment regimes from accelerated erosion as well as water quality changes through nutrient sources (allochthonous verses autochthonous) caused by changes in amount and structure of riparian vegetation (which may also alter water temperatures) and production of ash creating temporary increases in suspended solids and dissolved salts in local streams. The more complex the habitat where there are plenty of spaces between the cobble and gravel stream bottoms (i.e., less sedimentation from accelerated erosion) the better. Stream reaches which are naturally low in primary production with a large reliance on riparian inputs from energy sources such as large woody debris, which also helps to

create pool habitat and serves as sources of food for smallmouth bass prey (generally smaller fishes), are preferred.

The potential for soil erosion would be greatest during fireline construction or use of mechanical fuels treatment equipment. Physical barriers such as silt fences, straw bales, or waterbars would be placed as necessary to eliminate surface runoff into stream channels. Sites would be monitored after storms until new vegetation is established, to assure sediment would not enter stream channels.

Prescribed burning and mechanical fuels treatments along with the mitigation measures described in this assessment would not negatively alter habitat quality or water quality in local streams where the smallmouth bass lives.

Chemicals from herbicides can enter streams through direct application, drift, mobilization of residues in water, overland flow, and leaching. The most significant transport pathway would be direct application, drift, and mobilization during periods of heavy precipitation and overland flow. The most effective means for reducing this possible outcome is to maintain a buffer between the area for use and waterbodies, and to plan appropriately for application time frames which would mitigate concerns for contamination.

Cumulative effects
In general, prescribed fire and other fuels management approaches have little impact on water quality and habitat with respect to the smallmouth bass. When soils are deep and fire severity is low, few water quality changes have been observed, and those that have been reported are generally short lived (less than one year) (Elliot and Vose 2005, Knighton 1977). The prudent use of prescribed fire with the mitigations from BMPs and other Forest guidelines would result in minimal surface disturbance and erosion within the subwatersheds of the Lee Creek Unit and would help avoid impacts from large, intense wildfires.

Effects from no action alternative

Direct and indirect effects
This alternative would not cause any long-term negative effects on the analysis area except in the case of random fire events caused by increased fuel loads, drought, and/or arson. Wildfires in this area may cause more damage to water and soil resources than would wildfires in areas with regular prescribed burning which would negatively affect the smallmouth bass.

Cumulative effects
The possibility of intense wildfire events would not cause any cumulative negative effects on the smallmouth bass due to the resiliency of the landscape.

Aquatic Management Indicator Species 2 - Largemouth Bass
The largemouth bass is also a prized sport fish for anglers through Arkansas. It is found in many impoundments including lakes and ponds and some rivers and is less sensitive to temperature and turbidity than the smallmouth bass.

Effects from proposed action alternative

Direct and indirect effects
The proposed actions would have no direct or indirect effects on the largemouth bass.

Cumulative effects
Because there would be no direct or indirect effects – there would be no cumulative effects on the largemouth bass.

Effects from no action alternative

Direct and indirect effects
The no action alternative would have no direct or indirect effects on the largemouth bass.

Cumulative effects
Because there would be no direct or indirect effects, there would be no cumulative effects on the largemouth bass.

Terrestrial Threatened, Endangered, and Sensitive Species (TES)

White Nose Syndrome
White-nose syndrome (WNS) is a disease affecting hibernating bats. Named for the white fungus that appears on the muzzle and other parts of hibernating bats, WNS is associated with extensive mortality of bats in eastern North America. First documented in New York in the winter of 2006-2007, WNS has spread rapidly across the eastern United States and Canada, and the fungus that causes WNS has been detected as far south as Mississippi.

Bats with WNS act strangely during cold winter months, including flying outside in the day and clustering near the entrances of hibernacula (caves and mines where bats hibernate). Bats have been found sick and dying in unprecedented numbers in and around caves and mines. WNS has killed more than 5.7 million bats in eastern North America. In some hibernacula, 90 to 100 percent of bats have died.

Many laboratories and state and federal biologists are investigating the cause of the bat deaths. A newly discovered fungus, *Pseudogymnoascus destructans*, or pd, (formerly *Geomyces destructans*), has been demonstrated to cause WNS. Scientists are investigating the dynamics of fungal infection and transmission, and searching for a way to control it (USDI-FWS, 2014).

A low level of the fungus that causes white-nose syndrome in bats has been detected in two north Arkansas caves in 2013, including a cave on the Lee Creek unit. Approximately twelve bat deaths due to WNS have occurred in Arkansas at this time (Sasse 2015).

Terrestrial TE Species 1- Ozark big-eared bat

The Ozark big-eared bat is generally associated with caves, cliffs, and rock ledges in well drained, oak-hickory forests. Maternity caves and hibernacula occur in a number of different surroundings, from large continuous blocks of forest, to smaller forest tracts interspersed with open areas. Clark (1993) found that adult female Ozark big-eared bats from maternity colonies preferred to forage along woodland edges. By foraging along woodland edges the bat may benefit from a less cluttered environment, but cover is nearby and prey densities are high.

Foraging habitat for the Ozark big-eared bat is fair within the analysis area, particularly in the riparian areas and in the fields. Bat mist surveys conducted during June of 2008 by ASU did not catch this bat species within the analysis area. Surveys in the analysis area in 2014 and 2015 found this bat or indication that this species of bat had been using caves within the analysis area. The Lee Creek unit harbors both winter and summer foraging habitat for this bat (USDA, 2015).

Effects from proposed action alternative

Direct and indirect effects

No activities are planned that would impact either blufflines or caves favored by this species. Forest-wide standards, which require a vegetation buffer of 200 feet around all caves, would provide for the protection of all existing or discovered Ozark big-eared bat caves. Vegetation treatments as proposed would create more open foraging habitat for this species. Smoke contaminant monitoring has been conducted since 2003 on the Boston Mountain Ranger District. Results from the research indicated that prescribed burning caused some change at the entrance to caves, however, the effects of smoke were not noticeable in the twilight and dark of the caves where bats reside (USFS, 2003-2006, Odegard, Caviness and Rylee). Prescribed burning as proposed would create additional foraging habitat for this bat. The timing of burns is generally in the spring, which is past the time when this bat would be hibernating. Prescribed burns near areas of known karst, caves and bat hibernacula would have mitigations incorporated into prescribed burn plans to minimize smoke entering caves. Mechanical fuels treatments and fireline construction could cause some disturbance to this bat if residing near area of work, however, following forest plan standards and guidelines would minimize the potential for disturbance to the Ozark big-eared bat.

Herbicide use as proposed in the proposed action alternative would be applied at the lowest effective rate in meeting project objectives. All label instructions and RLRMP standards and guidelines would be followed. Forest wide standards and site specific analysis would minimize potential herbicide effects to bat species. A more detailed description of herbicide effects to mammals can be found in the BAE specialist report

(USDA, 2015) and in the MIS section of this EA. Construction of firelines and mechanical fuels treatments would have little to no effect to this species as it does not live in trees.

Cumulative effects
All activities with the proposed alternative are consistent with the RLRMP. In the Biological Assessment dated July 28, 2005, the Forest Wildlife Biologist (with concurrence from the USFWS), determined that the Ozark big-eared bat is "not likely to be adversely affected" from standard forest management, as long as the Forest Plan guidelines and mitigations are followed. Implementation of forest-wide standards for the protection of caves, karst habitats, and riparian areas would help protect needed hibernacula sites as well as potential foraging sites for these species. This constitutes compliance with Section 7 of the Endangered Species Act (ESA) with respect to future activities carried out on the Ozark-St. Francis National Forests. As described in the "Effects" section above, it is the determination of the BAE that the proposed action is "Not likely to adversely affect" the Ozark big-eared bat when combined with actions that occur on both private and Forest Service lands (USDA, 2015).

Effects from No action alternative

Direct and indirect effects
This alternative would likely not change the habitat for this species in the analysis area. Natural conditions would continue to occur-such as closed canopy conditions and continued fuel build up. This would create poor foraging habitat for this bat. Winter habitat would not be affected with this alternative. There would be no direct or indirect effects with implementation of this alternative.

Cumulative effects
There would be no known cumulative effects with the no action alternative when combined with activities that occur on private and Forest Service lands (USDA 2005a and 2015).

Terrestrial TE Species 2- Indiana bat
The Indiana bat is known to roost in the snags of 23 tree species (21 hardwood–2 pines) and rarely roosts in living trees. Twelve of these 23 have been designated as Class I trees; which means they are likely to develop loose exfoliating bark. Exfoliating (peeling) bark is a preferred roost location by Indiana bats. Class I trees include silver maple, bitternut hickory, eastern cottonwood, white oak, shagbark hickory, green ash, red oak, slippery elm, shellbark hickory, white ash, post oak and American elm (USDI-FWS, 1999c). Many of these species are found in stream valleys and lowlands and are infrequently encountered in upland pine and pine-hardwood timber stands where the dominant tree species is shortleaf pine. The potential habitat includes all Forest Service acres in Arkansas. The analysis area provides limited suitable summer foraging and roosting habitat for the Indiana bat near the riparian corridor. Suitable winter habitat is located north and west of the project area. Bat mist surveys conducted during June of 2008 by ASU did not catch this bat species within the analysis area. Bluff line surveys in

the analysis area in 2014 and 2015 did not find this species of bat. However, it is known to occur on the Lee Creek Unit, particularly at Devil's Den State Park and in Whitzen Hollow. The northeastern section of Lee Creek contains a five-mile management zone for the Indiana bat, with hibernacula located at Devils Den State Park (USDA, 2015).

Effects from proposed action alternative

Direct and indirect effects

No activities are planned that would impact either blufflines or caves favored by this species and there are no activities planned within the primary management zone for the Indiana bat near Devil's Den State Park. Forest-wide standards, which requires a vegetation buffer of 200 feet around all caves, would provide for the protection of all existing or discovered Indiana bat caves. The proposed treatments, to include mechanical fuels treatments and fireline construction would create more open foraging habitat for this species. Vegetation treatments would also create snag trees that this species of bat prefers to roost in during the summer. Smoke contaminant monitoring has been conducted since 2003 on the Boston Mountain Ranger District. Results from the research indicated that the effects of smoke were not noticeable in the twilight and dark of the caves where bats reside (USDA FS, 2003-2006, Odegard, Caviness and Rylee).

Herbicide use as proposed in the proposed action alternative would be applied at the lowest effective rate in meeting project objectives. All label instructions and RLRMP standards and guidelines would be followed. Forest wide standards and site specific analysis would minimize potential herbicide effects to bat species. A more detailed description of herbicide effects to mammals can be found in the BAE specialist report and in the MIS section of this EA.

Cumulative effects

All activities in the proposed action are consistent with the RLRMP. In the Biological Assessment dated July 28, 2005, the Forest Wildlife Biologist (with concurrence from the USFWS), determined that the Indiana bat is "not likely to be adversely affected" from standard forest management, as long as Forest Plan guidelines and mitigations are followed. Implementation of forest-wide standards for the protection of caves, karst habitats, and riparian areas would help protect needed hibernacula sites as well as potential foraging sites for these species. This constitutes compliance with Section 7 of the Endangered Species Act (ESA) with respect to future activities carried out on the Ozark-St. Francis National Forests. As described in the "Effects" section above, it is the determination of the BAE that the proposed action is "Not likely to adversely affect" the Indiana bat when combined with actions that occur on private and Forest Service lands (USDA, 2005a and 2015).

Effects from no action alternative

Direct and indirect effects
This alternative does not meet LRMP standards or guidelines to maintain viable populations of TES species. Natural conditions would continue to occur-such as increased fuel loading, which could increase the chance for a catastrophic wildfire. Foraging and roosting habitat would be negatively affected with this alternative. There would be little to no effect to winter habitat for this species. There would be no direct or indirect effects with implementation of this alternative.

Cumulative effects
There would be no known cumulative effects with the no action alternative when combined with activities that occur on both private and Forest Service lands (USDA, 2015).

Terrestrial TE Species 3- Gray bat
Gray bats are cave residents throughout the year, although different caves are usually occupied in summer than winter. Few individuals are found outside caves. They hibernate primarily in deep vertical caves with large rooms that act as cold air traps (Harvey, 1989). Gray bats forage primarily over water along rivers or near lake shores. The greatest threat to the species is vandalism by people during the winter while bats are in caves, or in the summer, when maternity cave sites could be disturbed. Winter hibernacula are scattered over the north portion of the state, but the largest known hibernacula is on the Sylamore Ranger District, where several hundred thousand bats gather in caves to spend the winter. Summer roost sites are more scattered and can vary from one year to the next. This bat can occur on any Ozark National Forest district with the possible exception of the Magazine Ranger District, which is south of the Arkansas River. The analysis area provides limited suitable summer foraging habitat, especially on the Lee Creek Unit. Suitable winter habitat within the Unit is in Whitzen Hollow and Devil's Den State Park. Bat mist surveys conducted during June of 2008 by ASU did not capture any gray bats. Bluff line surveys in the analysis area during 2014 and 2015 did not find this species of bat but this bat has been documented to occur on the Lee Creek unit (USDA, 2015).

Effects from proposed action alternative

Direct and indirect effects
No activities are planned that would impact either blufflines or caves favored by this species. Forest-wide standards, which requires a vegetation buffer of 200 feet around all caves, would provide for the protection of all existing or discovered gray bat caves. Prescribed burning, mechanical fuels treatments and fireline construction would create more open foraging habitat for this species. Smoke contaminant monitoring has been conducted since 2003 on the Boston Mountain Ranger District. Results from the research indicated that, the effects of smoke were not noticeable in the twilight and dark of the caves where bats reside (USDA FS, 2003-2006, Odegard, Caviness and Rylee).

Herbicide use as proposed in the proposed action alternative would be applied at the lowest effective rate in meeting project objectives. All label instructions and LRMP standards and guidelines would be followed. Forest wide standards and site specific analysis would minimize potential herbicide effects to the bat species. A more detailed description of herbicide effects to mammals can be found in the BAE specialist report and in the MIS section of this EA.

Cumulative effects
As described in the "Effects" section above, it is the determination of the BAE that the proposed action is "Not likely to adversely affect" the gray bat when combined with actions occurring on both private and public lands. The proposed action is consistent with the RLRMP (USDA, 2005a and 2015).

Effects from no action alternative

Direct and indirect effects
Natural conditions would continue to occur- such as increased fuel loading, which could increase the chance for a catastrophic wildfire. Foraging and roosting habitat would be negatively affected with this alternative. There would be little to no effect to winter habitat for this species. There would be no direct or indirect effects with implementation of this alternative.

Cumulative effects
There would be no known cumulative effects with the no action alternative when combined with activities that occur on both private and Forest Service lands (USDA, 2015).

Terrestrial TE (Proposed) Species 4-Northern Long-eared bat
The northern long-eared bat is among the most common of forest bats within at least the northern portions of the Southern Region and are frequently encountered in surveys within its extensive range throughout most of the Region. It is captured frequently on the Boston Mountain Ranger District and has been captured on the Lee Creek unit (USDA, 2015).

In October of 2013, the USFWS issued a proposed listing rule of endangered for the northern long-eared bat (NLEB) (78 FR 61046-61080). The USFWS subsequently released "Northern Long Eared Bat Interim Conference and Planning Guidance' (January 6, 2014, hereafter Guidance), providing recommendations for how to avoid take of any individual northern long-eared bat during the summer roosting period when conducting routine forest management. Most recently, due to new information, the USFWS determined a final listing rule is anticipated for April 1, 2015. The Southern Region completed a Biological Assessment for activities affecting the Northern long-eared bat, which is currently going through formal consultation (USDA, 2015).

The primary factor cited in the proposed listing rule that is responsible for the decline of NLEB populations is white-nose syndrome (WNS), a lethal fungal disease spread while the species inhabits caves and mines during winter hibernation. The NLEB has experienced a sharp decline in the northeastern part of its range, as evidenced by a combination of hibernacula surveys and summer capture trends. Although the disease has not yet spread throughout the species' entire range (WNS is currently found in 25 of 39 States where the NLEB occurs), it continues to spread. Because of shorter hibernation periods and warmer winters, it is not known if WNS would have the same impact to NLEBs in the southeast as it has in the northeast. The NLEB is a bat that utilizes both forest and caves or mines. Due to the proposed listing, it is considered for this analysis.

Effects from proposed action alternative

Direct and indirect effects

No activities are planned that would impact either blufflines or caves favored by this species. Forest-wide standards, which require a vegetation buffer of 200 feet around all caves, would provide for the protection of all existing or discovered Northern long-eared bat caves. Vegetation treatments as proposed would create more open foraging habitat for this species. Smoke contaminant monitoring has been conducted since 2003 on the Boston Mountain Ranger District. Results from the research indicated that the effects of smoke were not noticeable in the twilight and dark of the caves where bats reside (USDA FS, 2003-2006, Odegard, Caviness and Rylee). Prescribed burning as proposed would create additional foraging habitat for this bat. The timing of burns is generally in the spring, which is past the time when this bat would be hibernating. Prescribed burns near areas of known karst, caves and bat hibernacula would have mitigations incorporated into prescribed burn plans to minimize smoke entering caves. Mechanical fuels treatments and fireline construction could cause some disturbance to this bat if residing near area of work, however, following forest plan standards and guidelines would minimize the potential for disturbance to the NLEB. Roost trees utilized by this species could be lost during a prescribed burn or during fireline construction. This would be minimal and new roost trees would be provided. A recent publication by Silvis et. al, (2015) in Kentucky, suggested that the loss of a primary roost or < 20% of secondary roosts in the dormant season may not cause northern long-eared bats to abandon roosting areas or substantially alter some roosting behaviors in the following active season when tree-roosts are used (Silvis et. al, 2015).

Herbicide use as proposed in the proposed action alternative would be applied at the lowest effective rate in meeting project objectives. All label instructions and LRMP standards and guidelines would be followed. Forest wide standards and site specific analysis would minimize potential herbicide effects to bat species. A more detailed description of herbicide effects to mammals can be found in the BAE specialist report (USDA, 2015) and in the MIS section of this EA. Construction of firelines and mechanical fuels treatments could have a slight effect to roost trees if being utilized by this bat, however, the analysis area has an abundance of suitable roost trees and more could be created through the proposed treatments.

Cumulative effects
All activities with the proposed alternative are consistent with the LRMP. The guidelines recognize that prescribed fire and certain forest management practices, such as those described in the forest plan, can and do improve overall habitat conditions for a variety of bat species. The Forest Service has taken proactive measures to protect hibernacula from the spread of WNS and continues to implement adaptive forest management and prescribed fire activities as described in forest plans that are designed to minimize take of NLEB and other forest dependent species. Standards and guidelines have been adopted in the forest plan, for among other reasons, to promote the conservation of listed species and to avoid and minimize potential adverse effects of projects implemented under the forest plan. In addition, protection measures designed for the Indiana bat would further protect the NLEB.

In the Interim Conference Report July 21, 2014, the Region 8 Endangered Species Biologist, determined: *During the period between now and when a programmatic conference report is in place, we, the Forest Service, have determined that all forest and prescribed fire management activities on National Forests in the Southern Region, as described in Forest Plans, would not jeopardize the continued existence of the NLEB* (with concurrence from the USFWS) (USDA, 2015).

Terrestrial TE Species 5-American burying beetle – The environmental baseline is an analysis of the effects of past and ongoing human and natural factors leading to the current status of species, their habitats and ecosystem within the action area (USDI-FWS 1998). The ABB appears to be a habitat generalist with a slight preference for grasslands (grasses and forbs) and open understory. Considering the broad geographic range formerly occupied by the beetle, it is unlikely that vegetation or soil type were historically limiting. Carrion availability, and not habitat, may be the greatest factor determining where the species can survive. The preference of this insect for areas of grasses and forbs (as would be found in early forest stage cover habitat, open pine or hardwood woodlands) is not unexpected since many of the largest assemblages of appropriately sized small mammals and birds occur in these areas and their carcasses afford the beetle egg laying/brooding habitat (Hedrick 1993; Nebraska Game and Parks Commission 1995; USDI-FWS 1995). Numerous surveys have failed to document the occurrence of this species north of the Arkansas River in Arkansas. Habitat in the analysis area is excellent for this species (USDA, 2015).

Effects from proposed action alternative

Direct and indirect effects
Prescribed burning, mechanical fuels treatments or fireline construction as called for in the proposed action could harm individuals, however, because there have been no occurrences of this species historically or currently, there would be no direct or indirect effects with prescribed burning, mechanical fuels treatments or fireline construction. Prescribed burning can create some of the early successional habitat that this beetle prefers. Prescribed burning of area fields and wildlife openings would have long term

beneficial effects to American Burying Beetle habitat by creating the grassland like conditions that this species prefers. Herbicide use as proposed in the proposed action alternative would be applied at the lowest effective rate in meeting project objectives. All label instructions and RLRMP standards and guidelines would be followed. Forest wide standards and site specific analysis would minimize effects to this beetle. There would be no direct or indirect effects to this beetle with the proposed action as they have not been found in the area (USDA, 2015).

Generally, the indirect effects of forest management activities would be beneficial to American burying beetle (ABB) habitat in the proposed alternative. Increased establishment and maintenance of early seral habitat would provide enhanced habitat for the ABB food base of small vertebrate carrion. Indirect beneficial effects on ABB habitat would primarily involve maintenance and/or enhancement of grass/forb/shrub conditions that harbors small mammal and other potential carrion populations.

Cumulative effects
The cumulative effects of forest management activities in the proposed alternative on ABB habitat would be continued enhancement of the grass/forb habitat, providing conditions beneficial to this species, but ground-disturbing activities in proximity to individuals may directly harm them (USDA FS BA, 2005). As described in the "Effects" section above, it is the determination of the BAE that the proposed action would have "No effect" on the American burying beetle when combined with actions that could occur on private and public lands (USDA, 2005a and 2015).

Effects from no action alternative

Direct and indirect effects
Natural conditions would continue to occur such as closed canopy conditions and lack of woodland areas, which should result in no effects to the ABB as it has not been documented from the area. There would be no direct or indirect effects with implementation of this alternative.

Cumulative effects
There would be no known cumulative effects with the no action alternative when combined with activities that occur on both private and Forest Service lands (USDA, 2015).

Terrestrial Sensitive Species 6-Bald eagle – This species, recently de-listed as a threatened species, but still on the Regional Forester's sensitive species list, has been noted in the project area and is a common winter visitor to Frog Bayou, Lake Fort Smith, Lake Shepherd Springs, Shores Lake and the Mulberry River. Normal forest management activities, that take place well away from nest and communal roost areas and are well removed from large rivers, impoundments and other significant foraging areas, have little or no impacts on transient wintering bald eagles. This bird has been noted along Lee, Cove and Fall Creeks in the analysis area (USDA, 2015).

Effects from proposed action alternative

Direct and indirect effects
Any birds in the area during vegetation, fireline and mechanical fuels treatments work would likely move away temporarily to avoid the noise and traffic. All treatments proposed would not affect any known roost sites. Prescribed burning would not harm eagle roosting sites during the winter, since none occur there now.

Herbicide use as proposed in the proposed action alternative would be applied at the lowest effective rate in meeting project objectives. All label instructions and RLRMP standards and guidelines would be followed. Forest wide standards and site specific analysis would minimize effects to avian species. For a more detailed description of herbicide effects see the the MIS section of this EA and the BAE specialist report (UDA FS, 2015). There would be no direct or indirect impact on this species with the proposed alternative.

Cumulative effects
When the effects of the proposed action within the project area are combined with potential effects of all other planned or anticipated projects on both public and private lands, which would include the Lee Creek Fuels Treatment Project, there would be no cumulative impacts. The proposed action would not impact individuals, cause a decline in populations, affect the federal listing, or cause loss of viability to this avian species (USDA, 2015).

Effects from no action alternative

Direct and indirect effects
Natural conditions would continue to occur which would have no direct or indirect inpacts on the bald eagle with implementation of the no action alternative.

Cumulative effects
There would be no known cumulative effects with the no action alternative when combined with activities that occur on both private and Forest Service lands (USDA, 2015).

Botanical Sensitive Species 7-Ozark chinquapin – This species was listed as sensitive because it is threatened with destruction by a fungal disease. This species has been found during surveys by the District Biologist. The Ozark chinquapin is fairly common on the Boston Mountain Ranger District. Most trees on the District are small trees resulting from stump sprouts, with very few surviving to the age of producing seed.

Effects from proposed action alternative

Direct and indirect effects
Prescribed burning could be beneficial to this species, as it prefers disturbance, which often results in incidental stump sprouts. Repeated prescribed burns would be detrimental to individual plants. Herbicide treatments as proposed could have negative direct and indirect impacts to this species, however, mitigation measures, such as: "If Ozark chinquapin were located in an area to be treated with herbicide, the trees would be placed in a 60-foot buffer, inside which no treatment with herbicides or handtools would occur" (see Mitigations Measure of the EA) would protect this tree during proposed treatments. Fireline and mechanical fuels treatments work could impact individuals by directly uprooting the tree. This species is often found on the edge of clearings, such as powerline right-of-ways as it prefers some disturbance and open conditions. The proposed actions may impact some individuals; but is not likely to cause a trend to federal listing or loss of viability to this species of tree.

Cumulative effects
When the effects the proposed project are combined with potential effects of all other planned or anticipated projects on both public and private lands, there would be no known cumulative impacts on this species (USDA, 2015).

Effects from no action alternative

Direct and indirect effects
The would be direct and indirect negative impacts to this tree with this alternative, however, this species does prefer some disturbance. The lack of any type of management in the area could have a slight negative impact to the local population of this tree.

Cumulative effects
When the effects the proposed project are combined with potential effects of all other planned or anticipated projects on both public and private lands, there would be no known cumulative impacts on this species (USDA, 2015).

Terrestrial Sensitive Species 8-Eastern small-footed bat – This species prefers hibernating in caves or mines. In Arkansas, it is known in small numbers from only a few caves in the Ozarks. The distribution of this bat is from eastern Canada south to Alabama and west to Oklahoma. It is uncommon throughout most of its range. The potential habitat for this species is all Forest Service acres except the St. Francis, approximately 900,000 acres. This bat occurs in Newton, Searcy, Franklin, Logan and Stone Counties in Arkansas. Very little is known about feeding habits or reproduction in this species. This bat tends to hibernate near cave entrances; hence it may be vulnerable to freezing in abnormally severe winters. The most serious threat to this cave-dwelling bat is human disturbance during hibernation (NatureServe, 2012). This bat species was not captured during bat mist netting surveys in June of 2008 by Arkansas State University. Summer foraging

habitat and favorable winter habitat for this bat can be found on the Lee Creek unit in Whitzen Hollow and at Devils Den State Park (USDA, 2015).

Effects from proposed action alternative

Direct and indirect effects
Prescribed burning and vegetative treatments as proposed in the proposed action alternative would create additional foraging habitat for this bat. The timing of burns is generally in the spring, which is past the time when this bat would be hibernating. Constuction of firelines and mechanical fuels treatments work would provide the open foraging habitat that this bat prefers.

Herbicide use as proposed in the proposed action alternative would be applied at the lowest effective rate in meeting project objectives. All label instructions and RLRMP standards and guidelines would be followed. Forest wide standards for the protection of caves, karst habitats, and riparian areas would help protect needed hibernacula and roosting sites as well as potential foraging sites for this species.

Cumulative effects
There would be no known cumulative impacts to this bat with implementation of the proposed action. It is the determination of the BAE that the proposed actions in the Lee Creek Fuels Treatment Project would have no negative impacts to the Eastern small-footed myotis. Indirect beneficial impacts should result with implementation of the proposed action for this bat species (USDA, 2015) with improvement of foraging habitat.

Effects from no action alternative

Direct and indirect effects
Natural conditions would continue to occur, such as continuation of area fuel loading, which could result in a catastrophic wildlfire. There would be no direct or indirect effects with implementation of this alternative.

Cumulative effects
There would be no known cumulative effects with the no action alternative when combined with activities that occur on both private and Forest Service lands (USDA, 2015).

Botanical Sensitive Species 9-Ozark Spiderwort- This plant is endemic to the Ozark Mountains of Missouri, Oklahoma, and Arkansas and the Ouachita Mountains of western Arkansas and southeastern Oklahoma. There are fifteen extant populations in Missouri, more than that in Arkansas, and a few in Oklahoma. The species is considered relatively secure despite some documented declines due to construction of dams/impoundments. There are no known immediate rangewide threats such as habitat conversion. Numerous local potential threats are reported however, including housing developments, roadway

construction and maintenance, and herbicide use (Watson 1989). This plant was not found during field surveys in 2008 or 2014, however, there is potential habitat in the analysis area for this plant (USDA, 2015).

Effects from proposed action alternative

Direct and indirect effects
Prescribed burning could be beneficial to this species, as it prefers some disturbance. The construction of firelines or the mechanical fuels treatments work could have negative direct and indirect impacts to this plant by incidental uprooting of individual plants. Field surveys failed to note the presence of this species in the project area. Herbicide treatments as proposed in this alternative could have negative direct and indirect impacts to individual species, however, known sites of this plant are not in areas proposed for treatments.

Cumulative effects
Implementation of the proposed alternative would have no impacts to the Ozark spiderwort (USDA, 2015).

Effects from no action alternative

Direct and indirect effects
Natural conditions would continue to occur which would have little to no direct or indirect impacts on this plant as none are known to occur within the analysis area.

Cumulative effects
There would be no known cumulative effects with the no action alternative when combined with activities that occur on both private and Forest Service lands (USDA, 2015).

Botanical Sensitive Species 10-Southern lady-slipper- This plant is known to occur in 12 Arkansas counties and possibly others (Smith, 1988). The preferred habitat for this plant consists of moist floodplains along creeks and on rich moist slopes. The biggest threat to the plant is collection for commercial sale and digging for replanting in wildflower gardens. The plant appears to be able to tolerate certain timber management activities with some treatments, such as thinning being beneficial. This plant has been noted in the analysis area in the riparian corridors (USDA, 2015).

Effects from proposed action alternative

Direct and indirect effects
The LRMP sets aside a completely separate management prescription area for Riparian Area Corridors. These corridors encompass an area of 100-feet on each side of any perennial stream on the Forest. A set of management goals and standards are set aside for this management area and is part of the project area. The plan also calls for

Streamside Management Zones (SMZ) that range from 50 to 150 feet for all streams and springs depending on the slope of adjacent channel and if the stream is classified as perennial, defined channel, or as a spring. A more detailed description of these areas can be found in Water Resources section of the EA. These areas would further protect this plant from any potential negative impacts that the proposed action could cause. Fireline construction and mechanical fuels treatments work could impact individual plants through incidental uprooting. This is unlikely as activities are not proposed in the riparian areas other than some prescribed burning. Herbicide treatments as proposed in this alternative could have negative direct and indirect impacts to individual species; however, known sites of this plant were not found in areas proposed for treatments.

Cumulative effects
Implementation of the proposed alternative may impact individuals but is not likely to cause cumulative impacts, such as a declining trend to the Southern ladyslipper's federal listing or loss of viability (USDA, 2015).

Effects from no action alternative

Direct and indirect effects
Natural conditions would continue. There would be no negative direct or indirect effects with implementation of this alternative.

Cumulative effects
There would be no known cumulative effects with the no action alternative when combined with activities that occur on both private and Forest Service lands (USDA, 2015).

Botanical Sensitive Species 11-Nuttall's Cornsalad- This plant is restricted to western Arkansas. It was formerly reported in eastern Oklahoma; however, occurrences have not been confirmed there recently. It has not been found on the Forest. The Big Piney, Boston Mountain, Magazine, and Pleasant Hill Ranger Districts have limited potential habitat along stream bottoms in mixed hardwood stands. Main threats to this species include the use of chemical herbicides and fertilizers, the loss of field margin refuges, the decline of traditional systems of crop rotation, earlier harvests, and the introduction of extremely competitive crop plants. Habitat for this plant is fair in the analysis area, although it was not found during field surveys in 2008 or 2014.

Effects from proposed action alternative

Direct and indirect effects
Prescribed burning could be beneficial to this species, as it prefers disturbance. This plant generally occurs in riparian areas which are protected according to RLRMP guidelines (3-37). Herbicide treatments are not proposed in areas where this plant could be found. Fireline construction and mechanical fuels treatments work could harm individual plants through direct uprooting, however this plant was not found in the analysis area. Direct

and indirect beneficial benefits to this plant should occur with the proposed treatments, as it prefers open conditions that allow sunlight in.

Cumulative effects
Implementation of the proposed action would have no cumulative impacts to the this plant when combined with actions that could occur on both private and public lands (USDA, 2015).

Effects from no action alternative

Direct and indirect effects
Natural conditions would continue to occur which would have no direct or indirect inpacts on this plant with implementation of the no action alternative.

Cumulative effects
There would be no known cumulative effects with the no action alternative when combined with activities that occur on both private and Forest Service lands (USDA, 2015).

Botanical Sensitive Species 12-Blue Ridge catchfly
Favorable habitat would include talus slopes beneath sandstone bluff lines. This type of habitat is limited on the Forest. Surveys were conducted in the project area by contractor Biologist Gene Leeds in 2008 and the District Wildlife Biologist in 2014. This plant was not found in the project area, however, habitat is good for this plant and it is likely to occur in the project area, especially in the riparian area corridors.

Effects from proposed action alternative

Direct and indirect effects
Mechanical fuels treatments activity and fire line construction could adversely impact this species by disturbing habitat, by top killing the plant, or by opening the forest floor to more sunlight, which allows for drying the site and indirectly impacting plant habitat. Talus sites where this plant occurs would be protected by implementation of forest-wide standards, which limit harvest activities in these areas. Activities proposed should not affect this plant as it is generally found where management activities would not occur.

Herbicide treatments as proposed in the proposed action alternative could have negative direct and indirect impacts to individual species, however, this plant was not found in stands proposed for treatments. Although this species was not found during field surveys, habitat is good in the riparian corridors. Work as called for in the proposed action would not occur in the riparian corridors except for prescribed burning and possibly some fireline construction.

Cumulative effects
It is the determination of the BAE that due to protection and management direction

provided in forest wide standards and the plants resistance and expected response to treatments likely to be practiced where it could occur, a determination of "may impact individuals but not likely to cause a trend to federal listing or a loss of viability" is made for the Blue Ridge Catchfly for the proposed action (USDA, 2015).

Terrestrial Sensitive Species 13-Bachman's Sparrow**-** Historically, this species has been found in mature to old growth southern pine woodland that has been subjected to frequent growing-season fires. It is a fugitive species, breeding wherever fires create suitable conditions. This species requires a well-developed grass and herb layer with limited shrub and hardwood midstory components. Ideal habitat was originally the extensive longleaf pine woodlands of the south. It was able to colonize clear-cuts and early seral stages of old field succession but such habitat remains suitable only for a short time. Habitat within the project area is poor for this bird as the majority of the area is not open and in closed canopy conditions. This species requires dry, open pine or oak woodlands with an undercover of grasses and shrubs. There is less than 5% of the project area that has that type of habitat. This species was not found during field surveys in 2014 and no historic records are known from the analysis area.

Effects from proposed action alternative

Direct and indirect effects

Herbicide use as proposed in would be applied at the lowest effective rate in meeting project objectives. All label instructions and RLRMP standards and guidelines would be followed. Forest wide standards and site specific analysis would minimize effects to avian species. Habitat for this species in the proposed alternative would be improved immediately following prescribed burning (particularly when combined with other timber thinning projects) for 1-3 years following prescribed burn treatments. Indirect and direct beneficial impacts to potential habitat for this species would occur with the proposed alternative. Habitat for this bird would be beneficially impacted for the first 5-7 years of project implementation with the proposed action. Cowbird parasitism would potentially increase with fireline construction. There may be an increase in the number of predators in areas where treatments (fireline construction) would occur, however, the loss of individuals to predators would be small compared to the potential population gains following habitat improvement.

Cumulative effects

It is the determination of the BAE that the proposed action would have no cumulative impacts to the Bachman's Sparrow because it is not documented from the project area when combined with actions occurring on both private and Forest Service lands. There would be beneficial impacts to its habitat with implementation of the proposed action if this species did occur in the project area (USDA, 2015).

Effects from no action alternative

Direct and indirect effects
This alternative does not meet LRMP standards or guidelines to maintain viable populations of this species. Natural conditions would continue to occur-such as increased canopy closure, which would result in a continued decrease of the woodland conditions that this bird prefers. There would be negative direct or indirect effects with implementation of this alternative because habitat is extremely poor for this bird in the analysis area. Lack of active management could be detrimental to this species if it were to occur in the analysis area.

Cumulative effects
There would be no known cumulative effects with the no action alternative when combined with activities that occur on both private and Forest Service lands (USDA, 2015).

Botanical Sensitive Species 14-Ouachita False Indigo/Leadplant-This plant is most often found near streams on rocky outcrops or in open areas created by road construction or maintenance in full sunlight or light shade (Tucker, 1989). The usual habitat for the Ouachita leadplant seems to be on rocky, open and sunlit areas having reliable moisture. It occurs on glades, roadsides and along ephemeral drainages. Habitat in the analysis area is good for this plant and was not noted during field surveys in 2014 near Whitzen, Cove or Lee Creeks.

Effects from proposed action alternative

Direct and indirect effects
Prescribed burning and mechanical fuels treatments treatments could be beneficial to this species, as it prefers disturbance. However, this plant generally occurs in riparian areas which are protected according to LRMP guidelines (3-37). Herbicide treatments are not proposed in areas where this plant could be found. Direct and indirect beneficial benefits to this plant should occur with the proposed treatments, as it prefers open conditions that allow sunlight in.

Cumulative effects
Implementation of the proposed action would have no cumulative impacts to the this plant when combined with actions that could occur on both private and public lands (USDA, 2015).

Effects from no action alternative

Direct and indirect effects
Natural conditions would continue to occur which would have no direct or indirect inpacts on this plant with implementation of the no action alternative.

Cumulative effects
There would be no known cumulative effects with the no action alternative when combined with activities that occur on both private and Forest Service lands (USDA, 2015).

Aquatic Threatened, Endangered, and Sensitive Species (TES)

Aquatic Sensitive Species 1. Longnose darter
This small bottom-dwelling (benthic) fish has potential to be in the project area. Habitat preferences appear to be clear, silt-free, upland streams and small rivers with cobble and gravel bottoms. Spawning takes place in the riffles sections of streams from late March to mid-May. During periods of low flow, it is found in the deeper parts of pools in little or no current, often over a sandy bottom and frequently near aquatic vegetation.

Effects from proposed action alternative

Direct and indirect effects
Prescribed burning and mechanical fuels treatments along with the mitigation measures described in this assessment would not negatively alter habitat quality or water quality in streams where the longnose darter has potential habitat.

Cumulative effects
Because there would be no direct or indirect effects, there would be no cumulative effects on the potential habitat of the longnose darter.

Effects from no action alternative

Direct and indirect effects
There would be no direct or indirect effects on the potential habitat of the longnose darter except for the possibility of catastrophic wildfires within drainages with heavy fuel loads where darter populations may occur. Over time with the buildup of fuels in vulnerable areas wildfires may negatively affect soils by increasing the potential for vegetation loss and increased runoff. This could potentially lead to loss of habitat and degradation in water quality for the longnose darter.

Cumulative effects
For the no action alternative, where there is increasd chance of catastrophic wildfires vegetation loss and increased runoff would be temporary as vegetation quickly grows

back and sediment regimes return to normal. There should be no negative cumulative effect to potential habitat for the longnose darter with the no action alternative.

Aquatic Sensitive Species 2. *Lirceus bicuspidatus:* an aquatic isopod
This aquatic invertebrate is endemic to Arkansas. The actual distribution of this species is not well known. It is found in streams and caves with moving water. It has been found on the Ozark National Forest but to date has not been identified in the project area. However, this species has potential habitat in the analysis area.

Effects from proposed action alternative

Direct and indirect effects
Prescribed burning and mechanical fuels treatments along with the mitigation measures described in this assessment would not negatively alter habitat quality or water quality in streams where the isopod may occur.

Cumulative effects
Because there would be no direct or indirect effects, there would be no cumulative effects on the potential habitat of the isopod.

Effects from no action alternative

Direct and indirect effects
The project area has many areas of increased fuels loads which increases vulnerability of these areas to severe wildfires. Over time with the buildup of fuels in vulnerable areas wildfires may negatively affect soils by increasing the potential for vegetation loss and increased runoff, especially in areas with high slopes. This could potentially lead to loss of habitat and degradation in water quality in small drains where the isopod may occur.

Cumulative effects
For the no action alternative, catastrophic wildfires may occur, but vegetation loss and increased runoff would be temporary as vegetation quickly grows back and sediment regimes return to normal. There should be no negative cumulative effect to potential habitat for the isopod with the no action alternative.

Summarized Effects for all MIS and TES species for proposed action alternative:
There would be an initial flush of native herbaceous forbs due to herbicide treatments of non-native invasive species, prescribed burning and mechanical fuels treatment in the analysis area. This would in turn create beneficial habitat for a variety of wildlife species.

This alternative would create some early seral habitat for species such as deer, turkey and quail and improve the overall habitat carrying capacity of this area for six months to approximately three years following the prescribed burns.

Direct mortality of less mobile wildlife species such as shrews, voles, various reptiles and amphibians can be expected with landscape prescribed burning, mechanical fuels treatment and fireline construction. This loss is offset by the increased abundance of forage and insect numbers following a burn, which allows population numbers to increase beyond pre-burn levels. Fallen snags as a result of proposed treatments could eventually create cover for amphibians and sunning sites for reptiles.

Mechanical treatments such as disking and dozer work associated with fireline construction or reconstruction would disturb and potentially kill or harm insects, small mammals and reptiles at the time treatments take place. Improved forage and cover availability following this work would cause an increase in the numbers of insects and small mammals to population levels greater than before treatment initially. Construction of firelines and mechanical fuels treatment would temporarily disturb vegetation, but would increase sunlight to the ground. Long-term impacts on wildlife would be minimal. Some disturbance of wildlife can be expected and individuals of slower moving or less mobile species may perish during the construction process. Disturbance to wildlife due to the presence of humans and motor vehicles is expected to cause new patterns and behaviors to local area wildlife.

Prescribed burning and mechanical fuels treatment helps reduce stem densities as well as leaf litter and allows more sunlight to reach the ground restoring the herbaceous component lost in the closed canopy forest. A more open forest would improve browse, soft mast, grass and legume production for wildlife and create a more diverse habitat mix. The reduction in dead and down material through burning would also benefit forest health by stimulating the nutrient cycling process in the soil.

Herbicide Effects for all MIS and TES species

Herbicide use as proposed in the proposed action alternative would be applied at the lowest effective rate in meeting project objectives. All label instructions and LRMP standards and guidelines would be followed. Forest wide standards and site specific analysis would minimize effects to terrestrial species.

Terrestrial animals might be exposed to any applied herbicide from direct spray, the ingestion of contaminated media (vegetation, prey species or water), grooming activities, or indirect contact with contaminated vegetation. Species of wildlife are likely to spend longer periods of time, compared to humans, in contact with contaminated vegetation. (Syracuse Environmental Research Associates (SERA) 2003a). The highest exposures for terrestrial vertebrates would occur after ingesting contaminated vegetation or insects. The ingestion of treated vegetation over a prolonged period, however, seems implausible as plants are damaged and begin to die soon after herbicide is applied.

The current risk assessment for glyphosate generally supports the conclusions reached by the EPA. Based on the current data, it has been determined that effects to birds, mammals, fish and invertebrates are minimal (SERA 2003a). As with all longer term exposure scenarios involving the consumption of contaminated vegetation, the plausibility

of this exposure scenario is limited because damage to the treated vegetation (i.e., vegetation directly sprayed at the highest application rate) would reduce and perhaps eliminate the possibility of any animal actually consuming this vegetation over a prolonged period.

For terrestrial mammals, the central estimates of hazard quotients for triclopyr do not exceed the level of concern for any exposure scenarios (SERA 2003b). At the upper range of exposures, the hazard quotients exceed the level of concern for large mammals and large birds consuming contaminated vegetation exclusively at the application site. This risk assessment is consistent with the risk characterization given by the EPA indicating that contaminated vegetation is the primary concern in the use of triclopyr and that high application rates would exceed the level of concern for both birds and mammals in longer term exposure scenarios.

3.5 SAFETY AND HUMAN HEALTH

Fire can be dangerous if used inappropriately. When resource managers determine that prescribed fire is the right tool to accomplish management objectives, there are many other factors that must be taken into account. The burn plan for each burn unit outlines specific conditions or prescriptions needed to achieve the Forests' management goals. Detailed requirements and sequence of actions for a successful burn are part of the burn plan. For example, burn plans contain parameters that must be met prior to ignition such as ambient temperature, humidity levels, wind speed, and direction. The overriding factors in prescribed burns are safety and control. Burn managers insure that both smoke and fire are going in a safe and controllable direction.

Risk assessments were developed by examining a number of chemical exposure scenarios for the general public. For each pesticide, at least three general exposure scenarios are considered, including walking through a contaminated area shortly after treatment, the consumption of water from a contaminated watershed, and the consumption of contaminated vegetation. These scenarios are used because one of them usually leads to the highest estimates of exposure.

Ozark-St. Francis National Forests' staff conducted a thorough review of SERA/USFS risk assessments for each chemical proposed for use in this EA. This review was accomplished through reading risk assessment documents and examining exposure and contamination modeling through spreadsheets provided by SERA allowing assessments to be customized to local conditions including soils, rainfall, temperature and application rate of each pesticide.

Some, if not all, of these general exposure scenarios for the general public may seem implausible or at least extremely conservative. Estimates of longer-term consumption of contaminated water are based on estimated application rates (lbs./acre) and monitoring studies that can be used to relate levels in ambient water to treatment rates in a watershed; however, in most pesticide applications, substantial portions of a watershed

are not likely to be treated. Finally, the exposure scenarios based on longer-term consumption of contaminated vegetation assume that an area of edible plants is inadvertently sprayed and that these plants are consumed by an individual over a 90-day period. While such inadvertent contamination might occur, it is extremely unlikely to happen as a result of directed applications (e.g., backpack applications). Even in the case of boom spray operations, the spray is directed at target vegetation and the possibility of inadvertent contamination of cultivated or edible vegetation would be low. In addition, for herbicides and other phytotoxic compounds, it is likely that the contaminated plants would show obvious signs of damage over a relatively short period of time and would therefore not be consumed. Nonetheless, these general exposure assessments are included because the risk assessment is intended to be extremely conservative with respect to potential effects on the general public, and to provide estimates regarding the likelihood and nature of effects after human exposure to pesticides (Durkin 2007).

Effects from the proposed action alternative

Direct and indirect effects

To improve visitor safety, forest visitors would be prohibited from entering certain areas during prescribed burn activities. These activities would have no long-term negative effects on user safety. Overall, these actions should increase public safety due to the decrease of chances of wildfire from controlled consumption of fuels. Smoke from burning would cause temporary air quality problems for people with breathing difficulties or sensitivity. People with these conditions may need to leave the area of the burn on the day of the burn. This problem is temporary and is usually dissipated within a few hours.

Cumulative effects

A regular burning regime winthin the Lee Creek Unit on Forest Service lands would help to protect private lands by decreasing the chances for catastrophic wildfires. For wildfires that do occur, the intensities would be lower. Effects of prescribed burning to both the public and to forest workers are described in detail in the Vegetation Management FEIS Vol. 1, Chapter 4 pages 3-29 (USDA 1989). There would be no cumulative effects with actions proposed in this alternative.

The risk assessments prepared for the chemical treatments use parameters for large scale applications whose acreage exceeds the maximum size of treatments proposed in this EA. No significant effects would be seen to human health, surface or ground water quality, wildlife, aquatic organisms or non-target vegetation. Native vegetation would benefit from these treatments which may have a cascading effect upon ecological communities as a whole such as helping to increase habitat for pollinators and sensitive species.

Effects from the no action alternative

Direct and indirect effects

Decades of aggressive fire suppression efforts on National Forest System lands have disrupted the natural fire regime resulting in greater tree densities and a build-up of fuel

across large areas of the landscape. All this weakened excess vegetation has the potential to fuel large, dangerous wildfires. These fires threaten lives and property and degrade the landscape by killing trees, degrading water quality, overheating the soil and robbing it of nutrients, and harming wildlife and wildlife habitat.

Cumulative effects

Other than the increased potential for wildfires across the landscape there would be no cumulative effects to safety and human health with this alternative.

4.0 LIST OF PREPARERS AND AGENCIES/PERSONS CONSULTED

Jobi Brown: NEPA Coordinator/ Biologist/ID Team Leader– Boston Mountain Ranger District

Mike Hennigan: Timber Management Assistant – Boston Mountain Ranger District

Mike Klick: Assistant FMO -- Boston Mountain Ranger District.

Rhea Whalen: Wildlife Biologist – Boston Mountain Ranger District

Dr. Mary Brennan: Zone Archeologist – Pleasant Hill and Boston Mountain Ranger Districts

The following is a list of agencies and persons who were consulted during this analysis:

State Historic Preservation Office, Little Rock, AR

Resource Staff in the Forest Service Supervisor's Office, Russellville, AR:
Terry Krasko, Steve Duzan, and Dr. David Jurney

U.S. Fish and Wildlife Office, Conway, AR

Tribal Governments

5.0 REFERENCES

Tiered Documents

U.S. Department of Agriculture, Forest Service. 1989. Environmental Impact Statement, Vegetation Management in the Ozark/Ouachita Mountains (VMEIS), Vol. I and II. Management Bulletin R8-MB 23.

_____. 2005a. Revised Land and Resources Management Plan; Ozark-St. Francis National Forests. Russellville, AR; U.S. Department of Agriculture, Southern Region.

_____. 2005b. Final Environmental Impact Statement to the Revised Land and Resources Management Plan; Ozark-St. Francis National Forests. Russellville, AR; U.S. Department of Agriculture, Southern Region.

****

Abrams, M.D. 2003. Where has all the white oak gone? BioScience 53(10):927-939.

Arkansas Forestry Commission. 2002. Best Management Practices Guidelines for Water Quality Protection. 56 pp.

_____. 2007. Arkansas Smoke Management Guidelines. Guidelines for when to burn and how to manage smoke. Available at http://forestry.arkansas.gov/Services/KidsTeachersEveryone/Documents/ArkansasVSMG.pdf

Arkansas Game and Fish Commission. 2001. Strategic Quail Management Plan.

Baker, J.C. and W.C. Hunter. 2002. Effects of Forest Management on Terrestrial Ecosystems. *In*: Wear, D.N. and J.G. Greis, eds. Southern Forest Resource Assessment. Gen. Tech. Rep. SRS-53. Asheville, North Carolina: USDA Forest Service, Southern Research Station. 635 pp.

Blehert, D.S., A.C. Hicks, M. Behr, C.U. Meteyer, B.M. Berlowski-Zier, E. L. Buckles, J.T.H. Coleman, S.R. Darling, A. Gargas, R. Niver, J.C. Okoniewski, R.J. Rudd, and W.B. Stone. 2009. Bat white-nose syndrome: an emerging fungal pathogen? Science 323(5911): 227.

Boerner, R.E. J., J. Huang, et al. 2008. "Fire, thinning, and the carbon economy: effects of fire and fire surrogate treatments on estimated carbon storage and sequestration rate." Forest Ecology and Management 255: 3081-3097.

Broders, H.G. and G.J. Forbes. 2004. Interspecific and intersexual variation in roost site selection of northern long-eared and little brown bats in the Greater Fundy National Park ecosystem. Journal of Wildlife Management 68:602–610.

Brooks, R.T. 2009. Habitat-associated and temporal patterns of bat activity in a diverse forest landscape of southern New England, USA. Biodiversity and Conservation 18:529–545.

Brose, P. and D. VanLear 2004. Survival of Hardwood Regeneration during Prescribed Fires: The Importance of Root Development and Root Collar Location. *In*: Spetich, M.A. (Ed.), Proceedings of the Upland Oak Ecology Symposium: History, Current Conditions, and Sustainability. GTR-SRS-73. Asheville, NC: USDA Forest Service, Southern Research Station. pp 123-127. Available at http://www.srs.fs.usda.gov/pubs/6470

Brown, J. K. and J.K. Smith, eds. 2000. Wildland fire in ecosystems: Effects of fire on flora. Gen. Tech. Rep. RMRS-GTR-42-vol. 2. Ogden, UT: USDA Forest Service Rocky Mountain Research Station. 257 p.

Busse MD, CJ Shestak, KR Hubbert, and EE Knapp (2010). Soil physical properties regulate lethal heating during burning of masticated fuels. *Soil Science Society of America Journal* 74, 947–955.

Callaham, M.C. Jr.; Scott, D.A.: O'Brien, J.J.: Stanturf, J.A. 2012. Cumulative effects of fuel management on the soils of Eastern U.S. watersheds. USDA Forest Service GTR-SRS-161:202-221.

Carter, T. C. and G. A. Feldhamer, 2005. Roost tree use by maternity colonies of Indiana batsand northern long-eared bats in southern Illinois. Forest Ecology and Management 219(2-3): 259-268.

Caviness, M. 2003. Effects of prescribed fire on cave environment and bat inhabitants. Bat Research News 44:130.

Center for Advanced Spatial Technologies at University of Arkansas 2014. Arkansas Watershed Information System. Accessible at: http://watersheds.cast.uark.edu/

Clark, B. 1994. Soils, Water, and Watersheds, p.V-1 - V13 *in:* Melanie Miller (ed.) Fire Effects Guide. National Wildfire Coordinating Group.

Clingenpeel, A. 1993. Effectiveness of BMPs in Protecting Water Quality. Southern Forest Resource Assessment Draft Report 5.3
http://www.srs.fs.fed.us/sustain/report/aqua4/aqua4-08.htm.

Clingenpeel, A. and M.A. Crump. 2005. Sedimentation Model for the Boston Mountains/Ozark Highlands. Unpublished. Ozark-St. Francis National Forests, Supervisors Office, Russellville, AR.

DeBano, L.F.; Neary D.G.; Ffolliet, P.F. 2005. Wildland Fire in ecosystems, effects of fire on soil and water. U.S.D.A., Forest Service, Rocky Mountain Research Station, General Technical Report RMRS-GTR-42-volume 4. Chapter 2 soil physical properties: p 29-51.
Dickinson, Matthew B.; Lacki, Michael J.; Cox, Daniel R. 2009. Fire and the endangered Indiana bat. *In*: Hutchinson, T.F., ed. Proceedings of the 3rd fire in eastern oak forests conference; 2008 May 20-22; Carbondale, IL. Gen. Tech. Rep. NRS-P-46. Newtown Square, PA: U.S. Department of Agriculture, Forest Service, Northern Research Station: 51-75. http://www.nrs.fs.fed.us/pubs/gtr/gtr-p-46papers/04-dickinson-p-46.pdf

Dodd, L. E.; Lacki, M. J.; Rieske, L. K. 2008. Variation in moth occurrence and implications for foraging habitat of Ozark big-eared bats. Forest Ecology and Management 255:11: 3866-3872.

Dolan, B.J., and G.R. Parker. 2004. Understory response to disturbance: an investigation of prescribed burning and understory removal treatments. Gen. Tech. Rep. SRS-73. Asheville, NC. USDA Forest Service, Southern Research Station. pp. 285-291.

Durkin, P.R. 2007. Preparation of Environmental Documentation and Risk Assessments for the USDA/Forest Service. Syracuse Environmental Research Associates Inc. Fayetteville, New York 13066-0950. SERA MD 2007-01a

Edwards, P.J.; Troendle, C.A. 2012. Cumulative watershed effects of fuel management in the Eastern United States. USDA Forest Service GTR-SRS-161: (11): 229-273.

Elliot, K.J.; Vose, J.M. 2005. Initial effects of prescribed fire on quality of soil solution and stream water in the Southern Appalachian Mountains. Southern Journal of Applied Forestry. 29: 5-15.

Environmental Protection Agency 2012. http://epa.gov/air/criteria.html accessed 6 October 2014.

Foti, T. L. and M.S. Deval. 1994. Herbaceous Plant Biodiversity of Stands in the Ouachita and Ozark National Forests. Pages 50-60 *in* J.B. Baker, comp. Ouachita Mountains: Pretreatment Conditions and Preliminary Findings. U.S. Forest Service General Technical Rep. SO-112, New Orleans, LA.

Foti, T.L. and M. Spetich. 2004. Upland Hardwood Forests and Related Communities of the Arkansas Ozarks in the Early 19th Century. *In*: Spetich, M.A. (Ed.), Proceedings of the Upland Oak Ecology Symposium: History, Current Conditions, and Sustainability. GTR-SRS-73. Asheville, NC: USDA Forest Service, Southern Research Station. pp 3-9. Available at http://www.srs.fs.usda.gov/pubs/6470

Fox, S.F; P.A. Shipman; R.E. Thill; J.P Phelps and D.M. Leslie. Jr. 2002. Amphibian Communities Under Diverse Forest Management in the Ouachita Mountains, Arkansas.

Gen. Tech. Rep. SRS-74. Asheville, NC: U.S. Department of Agriculture, Forest Service, Southern Research Station. pp. 164-173.

Fralish, J.S. 2004. The Keystone Role of Oak and Hickory in the Central Hardwood Forest. *In*: Spetich, M.A. (Ed.), Proceedings of the Upland Oak Ecology Symposium: History, Current Conditions, and Sustainability. GTR-SRS-73. Asheville, NC: USDA Forest Service, Southern Research Station. pp 3-9. Available at http://www.srs.fs.usda.gov/pubs/6470

Gorham, B. 1999. Final Report: The 1999 Arkansas Land-Use/Land-Cover Project, Center for Advanced Spatial Technologies, University of Arkansas, Fayetteville, Arkansas. http://www.cast.uark.edu/local/arlulc99/final_report.htm

Guyette, R.P.; M.A. Spetich and M.C. Stambaugh 2006. Historic fire regime dynamics and forcing factors in the Boston Mountains, Arkansas, USA. Forest Ecology and Management. 234: 293-304.

Guyette, R.P and D. Day 2004. The effects of humans and topography on Wildland Fire, forests and species abundance. *In*: Spetich, M.A. (Ed.), Proceedings of the Upland Oak Ecology Symposium: History, Current Conditions, and Sustainability. GTR-SRS-73. Asheville, NC: USDA Forest Service, Southern Research Station. pp 128-131. Available at http://www.srs.fs.usda.gov/pubs/6470

Harvey, M.J., J.S. Altenbach, and T.L. Best. 2011. Bats of the United States. Arkansas Game and Fish Commission and U.S. Fish and Wildlife Service.

Johnson, J.B., W.M. Ford, and J.W. Edwards. 2012. Roost networks of northern myotis (*Myotis septentrionalis*) in a managed landscape. Forest Ecology and Management 266:223-231.

Kabrick, John M.; Dey, Daniel C.; Gwaze, David. 2007. Shortleaf pine restoration and ecology in the Ozarks: proceedings of a symposium. Gen. Tech. Rep. NRS-P-15. Newtown Square, PA: U.S. Department of Agriculture, Forest Service, Northern Research Station. 215p.

Kane JM, JM Varner, and EE Knapp (2009) Novel fuelbed characteristics associated with mechanical mechanical fuels treatment treatments in northern California and south-western Oregon, USA. *International Journal ofWildland Fire* 18, 686–697.

Keyser, P.D. and W.M. Ford. 2006. Influence of fire on mammals in eastern oak forests. Pages 180-190 *In* Fire in eastern oak forests: delivering science to land managers, Proceedings of a Conference November 15-17, 2005, Columbus, Ohio (M.B. Dickinson, ed.). USDA Forest Service General Technical Report NRS-P-1.

Kolka, R.K. 2012. Cumulative watershed effects of fuel management in the Eastern United States. USDA Forest Service GTR-SRS-161: (12): 282-291.

Jacobson, R.B. and A. Primm. 1994. Historic Land-Use Changes and Potential Effects On Stream Disturbance in the Ozark Plateaus, Missouri. USGS Open-File Report 94-233. Rolla, MO. 95 pp.

Lacki, M.J. and J.H. Schwierjohann. 2001. Day-roost characteristics of northern bats in mixed mesophytic forest. Journal of Wildlife Management 65:482-488.

Lacki, M.J., D.R. Cox, L.E. Dodd, and M.B. Dickinson. 2009. Response of northern bats (Myotis septentrionalis) to prescribed fires in eastern Kentucky forests. Journal of Mammalogy 90:1165-1175.

Lawson, E.R. 1986, effects of forestry practices on water quality in the Ozark-Ouachita highlands, *in* eds. Blackmon, B.G., Proceedings Forestry and Water Quality: A mid-south symposium, Little Rock, Ar, May 1985.

Lawson E.R. and L.H. Hileman. 1982. Nutrient distributions in runoff from Ouachita mountain watersheds. *In* proceedings second biennial southern silviculture research conference. Jones E.P. ed., Atlanta, GA., USDA FS southeastern forest experimental station p. 477-482.

Lawson, E.R., T.L Rogerson, and L.H Hileman. 1985, Water quality of stormflows from hardwood forested catchments in the Boston Mountains, presented 5th Central Hardwood Forest Conference, Urbana, IL April, 1985. p.215-221

Loeb, S.C. and J.M. O'Keefe. 2011. Bats and gaps: the role of early successional patches in the roosting and foraging ecology of bats. Pages 167-189 in Sustaining Young Forest Communities (C. Greenberg, B. Collins, and F. Thompson, eds.). Managing Forest Ecosystems, Vol 21. Springer-Verlag, New York City, NY.

Lorch, J.M., L.K. Muller, R.E. Russell, M. O'Connor, D.L. Lindner, and D.S. Blehert. 2013. Distribution and environmental persistence of the causative agent of white-nose syndrome, *Geomyces destructans*, in bat hibernacula of the eastern United States. Applied and Environmental Microbiology 79(4):1293-1301.

Luensmann, P.S. 2005. *Myotis sodalis*. *In*: Fire Effects Information System, [Online]. U.S.Department of Agriculture, Forest Service, Rocky Mountain Research Station, Fire Sciences Laboratory (Producer). Available: http://www.fs.fed.us/database/feis/animals/mammal/myso/all.html

Lynch, J.A. and S.C. Edwards. 1991. Long term implications of forest harvesting on nutrient cycling in central hardwood forests. Proceedings of the eighth central hardwoods forest conference.

MacGregor, J.R.; Kiser, J.D.; Gumbert, M.W.; Reed, T.O. 1999. Autumn roosting habitat of male Indiana bats (*Myotis sodalis*) in a managed forest setting in Kentucky. *In*: Stringer,

J.W.; Loftis, D.L., eds. Proceedings, 12th central hardwood forest conference; 1999 February 28-March 2; Lexington, KY. Gen. Tech. Rep. SRS-24. Asheville, NC: U.S. Department of Agriculture, Forest Service, Southern Research Station: 169-170.

Maharaj, V. and J. Carpenter. 1999. The Economic Impacts of Fishing, Hunting, and Wildlife Viewing on National Forest Lands. Report prepared for: Wildlife, Fish, and Rare Plants, U.S. Forest Service, U.S. Department of Agriculture. Appendix 11 and Appendix 12, pp. 40-41.

McDougal, L. A.; K. M. Russell; and K. N. Leftwich, eds. 2001. A Conservation Assessment of Freshwater Fauna and Habitat in the Southern National Forests. USDA Forest Service, Southern Region, Atlanta, Georgia. R8-TP 35 August 2001.

Menzel, J.M., W.M. Ford, M.A. Menzel, T.C. Carter, J.E. Gardner, J.D. Gardner, and J.E. Hofmann. 2005. Summer habitat use and home-range analysis of the endangered Indiana bat. Journal of Wildlife Management 69(1):430-436.

Miller, J.H. 2003. Nonnative Invasive Plants of Southern Forests: A Field Guide for Identification and Control. Gen. Tech. Rep. SRS-62. USDA, Forest Service. Southern Research Station. Available at http://www.invasive.cor/weeds/usfsr8.

Morris, A.D., D.A.Miller and M.C. Kalcounis-Rueppell. 2010. Use of forest edges by bats in a managed pine forest landscape. Journal of Wildlife Management 74:26–34.

National Wild Turkey Federation 2010.
http://www.nwtf.org/nwtf_newsroom/press_releases.php?id=12898

O'Keefe, J.M. 2009. Roosting and foraging ecology of forest bats in the Southern Appalachian Mountains. PhD Dissertation. Clemson University, Clemson, SC.

Owen, W. 2010. Best Management Practices for Selecting and Using Management Indicator Species. USDA Forest Service, WO, Washington, DC.

Patric, J.H. 1989. Effects of wood products harvest on forest soil and water resources with emphasis on clearcutting in moist climates. Northeastern Forest Experiment Station.

Patric, J.H., I.O Evans, and J.D Helvey. 1984. Summary of sediment yield data from forested land in the US: Journal of Forestry, v. 82(2), p. 101-104.

Robichaud, P.R.; Waldrop, T.A. 1994. A comparison of surface runoff and sediment yields from low-and high- severity site preparation burns. Water Resources Bulletin. 30: 27-34.

Patriquin, K.J., M.L. Leonard, H G. Broders, and C.J. Garroway. 2010. Do social networks of female northern long-eared bats vary with reproductive period and age? Behavioral Ecology and Sociobiology 64:899-913.

Perry, R. 2012. A Review of Fire Effects on Bats and Bat Habitat in the Eastern Oak Region. Proceedings of the 4th Fire in Eastern Oak Forests Conference. GTR-NRS-P-102.

Rogerson, T.L. and E.R Lawson. 1982, Hydrological characteristics of mixed hardwood watersheds in the Boston Mountains, *in* ed. Muller, R.N. Proceedings of the Fourth Central Hardwood Forest Conference. University of Kentucky, Lexington KY pg. 344-349.

Rosgen, D. 1996. Applied River Morphology. Wildland Hydrology, Pogosa Springs, Colorado. 389 pp.

Rudis, V.A. 1991. Fire's Importance in South Central U.S. Forests: Distribution of Fire Evidence. *In*: Nodvin, S.C. and Waldrop, T.A., eds. Fire and the Environment: Ecological and Cultural Perspectives; Proceedings of an International Symposium. 1990 March 20-24; Knoxville, TN. USDA, Forest Service, Southeastern Forest Experiment Station. Gen. Tech. Rep. SE-69. Asheville, North Carolina. 240-251.

Sabo, G.; A.M. Early; J.C. Rose; B.A. Burnett; L. Vogele and J.P. Harcourt 1990. Human Adaptation in the Ozark and Ouachita Mountains. Arkansas Archeological Survey Research Series 31, Fayetteville.

Sasse, B. 2015. *Pers. Comm.* with Rhea Whalen, district wildlife biologist.

Schroeder, R.L. 1985. Habitat suitability index models: eastern wild turkey. Biol. Rep. 82(10.106). Washington, DC: U.S. Department of Agriculture, Fish and Wildlife Service. 33 pp.

Schuler, J.L. and H.O. Liechty 2005. Seed bank emergence following prescribed burning in the Ozark Highlands. Pages 516-524 *in* proceedings of the 16th Central Hardwoods Forest Conference.

Schultes, K.L. 2002. Characteristics of roost trees used by Indiana Bats and Northern Bats on the Wayne National Forest, Ohio. Unpublished M.S. thesis, Eastern Kentucky University, Richmond. 141 pp.

Sheets, J.J. 2010. Impact of Forest Management Techniques on Bats with a Focus on the Endangered Indiana Myotis (*Myotis sodalis*). Thesis (M.S.)--Indiana State University. 70p. http://scholars.indstate.edu/bitstream/10484/962/1/Sheets%2c%20Jeremy.pdf

Sheets, J.J., J.O. Whitaker, Jr., V. Brack, Jr., and D.W. Spark. 2013. Habitat use by bats in two Indiana forests prior to silvicultural treatments for oak regeneration. Pages 203-217 *In* The Hardwood Ecosystem Experiment: a framework for studying responses to forest

management (R.K. Swihart, M.R. Saunders, R.A. Kalb, G.S. Haulton, and C.H. Michler, eds.). GTR NRS-P-108. U.S. Department of Agriculture, Forest Service, Northern Research Station. Newtown Square, PA.

Silvis, A., W.M. Ford, E.R. Britzke and J.B. Johnson. 2014. Association, roost use and simulated disruption of *Myotis septentrionalis* maternity colonies. Behavioural Processes 103:283–290.

Smith, E.B. 1988. An Atlas and Annotated List of the Vascular Plants of Arkansas. University of Arkansas Press, Fayetteville, Arkansas.

Sparks, D.W., C M. Ritzi, J.E. Duchamp and J.O. Whitaker, Jr. 2005. Foraging Habitat of the Indiana Bat (*Myotis sodalis*) at an Urban-Rural Interface. Journal of Mammalogy , Vol. 86, No. 4 (Aug., 2005), pp. 713-718.

Spetich, M.A. and H.S. He 2008. Oak decline in the Boston Mountains, Arkansas USA: Spatial and temporal patterns under two fire regimes. Forest Ecology and Management 254:454-462.

Stanturf, J.A., Wade, D.D., Waldrop, T.A., Kennard, D.K., and G.L. Achtemeier. 2002. Fire in Southern Forest Landscapes. Pages 607-630 *in*: Wear, D.M. and J. Greis (eds). Southern Forest Resource Assessment. Gen. Tech. Report SRS-53. USDA Forest Service, Southern Research Station. Asheville, NC. Available at: http://www.srs.fs.usda.gov/sustain/index.htm

Stevenson, A.P.; R.M. Muzika and R.P. Guyette. 2008. Fire Scars and Tree Vigor Following Prescribed Fire in the Missouri Ozark Upland Forests. Available at http://web.missouri.edu/~guyetter/pubs.html

Summerville, K.S. and T.O. Crist. 2002. Effects of timber harvest on forest Lepidoptera: Community, guild, and species responses. Ecological Applications 12:820-835.

Taylor, D.A. 2006. Forest Management and Bats. Bat Conservation International. http://www.batcon.org/pdfs/ForestMgmtandBats.pdf

Thomas, D.W., M. Dorais, and J.M. Bergeron. 1990. Winter energy budgets and cost of arousals for hibernating little brown bats, *Myotis lucifugus*. Journal of Mammalogy 71:475-479.

Titchenell, M.A., R.A. Williams, and S.D. Gehrt. 2011. Bat response to shelterwood harvests and forest structure in oak-hickory forests. Forest Ecology and Management 262:980-988.

USDA Forest Service 1989. Technical Publication R8-TP11. A Guide for Prescribed Fire in Southern Forests. Available at http://www.fs.fed.us/rm/pubs/rmrs_gtr292/1989_wade.pdf.

_____1992. Liberty Project Environmental Assessment.

_____1995. Southern Region Annual Fire Report. U.S. Department of Agriculture, Southern Region.

_____2005. Forest Service Manual 2600. National Headquarters, Washington D.C.

_____2014a. BAE specialist report.

_____2014b. Heritage report for Lee Creek Fuels Treatment Project.

_____2014c. Forest Health Technical Enterprise Team – National Insect and Disease Risk Maps and Report. Available at: http://www.fs.fed.us/foresthealth/technology/nidrm.shtml#NIDRMReport

_____2014d. Draft Biological Assessment Activities Affecting Northern Long-Eared Bats for the Southern Region National Forests, Region 8. Atlanta, Georgia.

_____2014e. Non-jeopardy Interim Conference Report for the Continued Implementation of Forest Service Southern Region Land and Resource Management Plans and Associated Projects Report. Atlanta, Georgia.

USDA Natural Resource Conservation Service 2013. Soils surveys available at: http://soils.usda.gov/survey/online_surveys/arkansas/

USDI Fish and Wildlife Service. 2011a. Supporting Decontamination Documentation for Researchers (WNS Decontamination Supplement 2 of 2). Version 01.25.2011.

_____2011b. National Plan for Assisting States, Federal Agencies, and Tribes in Managing White-Nose Syndrome in Bats. Plan 413/253 020. Hadley, MA.

_____2012. News Release: North American bat death toll exceeds 5.5 million from white-nose syndrome. Accessed on January 30, 2015 at https://www.whitenosesyndrome.org/news/forest-service-extends-closure-abandoned-mines-and-caves-new-studies-indicate-55-million-bats

_____2013. Federal Register: 50 CFR Part 17 Endangered and Threatened Wildlife and Plants; 12-Month Finding on a Petition To List the Eastern Small-Footed Bat and the Northern Long-Eared Bat as Endangered or Threatened Species; Listing the Northern Long-Eared Bat as an Endangered Species; Proposed Rule Vol. 78 Wednesday, No. 191 October 2, 2013.

_____2014a. http://www.fws.gov/wetlands/Data/State-Downloads.html

_____2014b. “Northern Long Eared Bat Interim Conference and Planning Guidance” Report. Atlanta, Georgia.

_____2015. White-Nose Syndrome Information-website. Accessed on 01/10/2015 at: https://www.whitenosesyndrome.org/

Van Lear, D.H. 2004. Upland Oak Ecology and Management. *In*: Spetich, M.A. (Ed.), Proceedings of the Upland Oak Ecology Symposium: History, Current Conditions, and Sustainability. GTR-SRS-73. Asheville, NC: USDA Forest Service, Southern Research Station. pp 65-71. Available at http://www.srs.fs.usda.gov/pubs/6470

Waldrop, T.A and S.L. Scott 2012. Introduction to prescribed fire in Southern ecosystems. Science Update SRS-054. Asheville, N.C. USDA Dept. Agriculture Forest Service, Southern Research Station. 80 p.

Watson, L.E. 1989. Status survey of *Tradescantia ozarkana*, Ozark spiderwort, in Oklahoma. Oklahoma Natural Heritage Inventory, Norman. 8 pp.

Weeks, M.L 1995. Soil Disturbance Monitoring on the Ozark-St.Francis N.F.s. 1993-1995. Unpublished Report. USDA Forest Service. Russellville, AR.

_____. 2002. Soil Disturbance Monitoring on the Ozark National Forest 1996-2002. Monitoring Data. USDA Forest Service. Russellville, AR.

Whitaker, Jr., J.O. and W.J. Hamilton 1998. Mammals of the Eastern United States. Cornell Univ. Press, Ithaca, NY.