ENVIRONMENTAL ASSESSMENT

The Indiana Bat Habitat Restoration Project

National Forest System lands within T15N-R10W Sec. 6; T15N-R11W Sec. 1-12; T15N-R12W Sec. 1-12;T16N-R10W Sec. 30,31; T16N-R11W Sec. 1-36; T16N-R12W Sec. 1-36;T16N-R13W Sec. 1,12,13,14,24,25,36; T17N-R11W Sec. 7,15-22,26-35;T17N-R12W Sec. 10-12,13-16,20-36, and T17N-R13W Sec. 36
Stone and Baxter Counties, AR

Region 8, Forest Service
United States Department of Agriculture
Ozark-St. Francis National Forests
Sylamore Ranger District
1001 East Main
Mountain View, AR 72560

July 2013

Responsible Official:
James R. McCoy
District Ranger
Sylamore-St. Francis Ranger Districts
(870) 269-3228

For Information Contact:
Jan Franks
District National Environmental Policy Act Coordinator
Sylamore-St. Francis Ranger Districts
(870) 269-3228 ext 3234

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	
	Page

INTRODUCTION	1
Desired Conditions	3
Existing Conditions	4
Purpose and Need for Action	5
ALTERNATIVES	8
Public Involvement	8
Summary of Alternatives	10
Alternative 1: No Action	10
Alternative 2: Proposed Action	10
Alternative 3: Reduced Herbicide	11
Alternatives Considered but Eliminated from Further Development	23
Adaptive Management	26
Decision Framework	27
ENVIRONMENTAL CONSEQUENCES	28
Forest Database	28
Effects Analysis Area and Timeframe	28
Documents Incorporated by Reference	28
Management Areas	29
Congressionally Designated Areas	30
Past, Present and Reasonably Foreseeable Actions	31
Forest Service Actions	31
Actions on Private Land	32
Physical Environments	34
Soil	34
Water Quality	40
Air Quality	55
Climate Change	65
Biological Environments	67
Major Forest Communities, Rare Communities and Non-native Invasive Plant Species	67
Major Forest Communities	67
Rare Communities	75
Non-native Invasive Plant Communities	82
Threatened, Endangered and Regional Forester's Sensitive Listed Species	92
Other Terrestrial and Aquatic Species	94
Management Indicator Species	94
Insect Prey of Indiana Bats	98
Neotropical Migratory Birds	100
Aquatic Communities	103

TABLE OF CONTENTS	
Social Environments	105
Human Health and Safety	105
Heritage Resources	110
Scenic Values and Recreation	115
Transportation System	127
Economics and Local Communities	130
Civil Rights and Environmental Justice	133
Irreversible or Irretrievable Commitment of Resources	134
COORDINATION AND CONSULTATION	135
Interdisciplinary Team Members	135
Contributing Forest Service Specialists	135
Consulting Forest Service Specialists	136
Scoping Lists	136
Native American Tribes	136
Government Agencies	137
Organizations	138
Individuals on the District's Mailing List	139
Private Landowners and Other Individuals	140
LIST OF TABLES	
1. Conditions for Treatments	12
2. Adaptive management monitoring summary	17
3. Comparison of activities proposed for each developed alternative	20
4. Management Areas within the Indiana Bat Habitat Restoration Project area boundary	30
5. Soil map unit characteristics within the Indiana Bat Habitat Restoration Project area	35
6. 6th Level Watersheds Contained in the Indiana Bat Habitat Restoration Project area	40
7. Sources of regional haze pollutants	58
8. V-Smoke modeling results for the 22 prescribed burn units based on worst-case firing and meteorological conditions	62
9. Major forest communities within the Indiana Bat Habitat Restoration Project area	67
10. Approximate age class distribution of forested acres within the Indiana Bat Habitat Restoration Project area based on existing available data	68
11. Approximate acres of high, medium and low quality glade within the Indiana Bat Habitat Restoration Project area based on survey by The Nature Conservancy	77
12. Non-native invasive plant species from the regional forester's list that are found in arkansas or that pose a threat to arkansas ecosystems	84
13. Estimation of acres with non-native invasive plant infestations within the	89

TABLE OF CONTENTS	
Indiana Bat Habitat Restoration Project area	
14. Determination of effect for federally listed threatened or endangered species known to occur or with potential to occur on the Sylamore Ranger District	92
15. Determination of impact for Regional Forester's (R8) sensitive listed species known to occur or with potential to occur on the Sylamore Ranger District	92
16. Data from Bird Point plots within the Indiana Bat Habitat Restoration Project area from 1996-2011	101
17. Prehistoric property types within the Indiana Bat Habitat Restoration Project area by landtype association	111
18. Miles of authorized road by jurisdiction in the analysis area	127
19. Miles of authorized road by Maintenance Level in the analysis area	127
20. Miles of authorized roads maintained within the analysis area over a 3 year period	128
LIST OF FIGURES	
1: Vicinity of the Indiana Bat Habitat Restoration Project area	6
2: Estimated percent canopy cover within the Indiana Bat Habitat Restoration Project area	7
3: Water Quality and Hydrology Effects Analysis Area	41
4: Arkansas 8 hour Ozone Maintenance Areas (1997 standard)	56
5: Areas that qualify as glade ecological classification within the Indiana Bat Habitat Restoration Project area	78
6: Fire regime condition class data shows over 75% of the landscape departs from historic fire regimes40	118
7: A map of project area sce58nic integrity objectives shows that much of the project area has a "high" scenic integrity objective	121
APPENDICES	
A. Detailed Descriptions of Alternatives 2 and 3	
B. Maps not Provided in the Body of the Environmental Assessment	
C. Biological Evaluation and Regional Forester's Sensitive Listed Species Assessment	
D. Soil	
E. Ozark-St. Francis National Forests Herbicide Monitoring Plan (2007)	
F. Key Regulated Pollutants and Their Significance in Smoke	
G. Insects and Diseases Affecting Hardwood and Pine Species	
H. USDA Forest Service National Forest System Data Recording Protocols and Requirements for Invasive Species Survey, Inventory and Treatment (2012)	
I. Ozark-St. Francis National Forests Threat Decision Matrix for Non-native Plant Species	
J. Procedures for Inadvertent Discovery of Human Remains and Burials	
K. Scenic Integrity Level Descriptions and Scenic Stability Definitions	

TABLE OF CONTENTS	
L. Fire Regime Condition Class	
M. Cited Literature and References	
ERRATA	

INTRODUCTION

What are we proposing?
The Sylamore Ranger District of the Ozark-St. Francis National Forests is proposing to treat up to 67,151 acres of National Forest Service land over a period of 12 years to create and maintain canopy closure and other forest conditions that will support the recovery of endangered Indiana bat populations. We are also proposing to gate known Indiana bat winter roosts (caves used for hibernation or hibernacula) to prevent human disturbance during a critical resting period (potentially including the inadvertent introduction of the devastating fungal disease known as White-nose syndrome).

The following actions are proposed:

- Cave gates would be installed on and/or fencing would be installed around extant (currently used) hibernacula, an historic hibernaculum if use resumes as well as any other caves if use as a hibernacula is discovered.
- Commercial timber harvests (no more than 3,500 acres/year) and associated activities to extract timber which include
    - construction of temporary roads, log landings and skid trails where needed;
    - road reconstruction (no more than 10 miles/year), and
    - purchaser road maintenance (no more than 15 miles/year);
- Reforestation (no more than 700 acres/year);
- Site preparation and timber stand improvement activities (no more than 2,000 acres/year of mechanical, manual, chemical or burning treatments combined),
- Wildlife stand improvement activities (no more than 2,000 acres/year of mechanical, manual, chemical or burning treatments combined),
- Prescribed burning (an average of 15,000 acres/year for all purposes) with no more than 2.0 miles of new mechanically constructed prescribed fire containment line/year;
- Mechanical treatments (no more than 600 acres/year);
- Treatment of non-native invasive plant species (no more than 1,100 acres/year with chemical herbicide);
- Monitoring and reporting

Additional details are included in the description of Alternative 2 in Appendix A. In general, these actions are similar to actions recently analyzed and implemented in the Ramsey Knob, Rorie and Sugarloaf projects.

Where are we proposing to act?
The Sylamore Ranger District is located in north-central Arkansas. The proclamation boundary lies approximately 80 air miles north of Little Rock, AR and 19 air miles south of the Arkansas-

Missouri line. Comprised of approximately 133,500 total acres, the District occurs within portions of four counties: Baxter, Stone, Marion and Searcy.

The *Indiana Bat Habitat Restoration Project* area (project area) represents the geographical extent of public and private lands within the proclamation boundary of the Sylamore Ranger District that o3ccur within a five mile radius of known extant and historic Indiana bat hibernacula (approximately 87, 243 acres total). **No activities are being proposed on private land for this project.**

The project area is bound on the south by the District proclamation boundary and on the east by the White River. Recognizable landmarks such as roads, streams, and bluff lines form the project area's northern and western boundaries. Approximately 67,151 acres of National Forest System land and 20,092 acres of private land within the following locations in Stone and Baxter Counties comprise the project area: T15N-R10W Sec. 6; T15N-R11W Sec. 1-12; T15N-R12W Sec. 1-12; T16N-R10W Sec. 30,31; T16N-R11W Sec. 1-36; T16N-R12W Sec. 1-36; T16N-R13W Sec. 1, 12, 13, 14, 24, 25, 36; T17N-R11W Sec. 7,15-22, 26-35; T17N-R12W Sec. 10-12, 13-16, 20-36, and T17N-R13W Sec. 36. These areas are shown on the Norfork Dam South, Norfork SE, Calico Rock, Boswell, Sylamore, Fifty Six, and Onia USGS 7.5-minute quadrangle maps which may be viewed online at http://viewer.nationalmap.gov/viewer/ or at the Sylamore District Ranger Station (District Office) in Mountain View, AR. A map illustrating the vicinity of the Sylamore Ranger District and project area is shown in Figure 1.

Why are we proposing to act?

The Indiana bat (*Myotis sodalis*) is a Federally-listed endangered species. Threats include human disturbance of hibernating bats. Indiana bats are vulnerable to disturbance because they hibernate in large numbers in a relatively limited number of caves. Other threats include loss of summer habitat, and most recently, White-nose syndrome. A recovery plan has been prepared, and is currently in the process of revision. The current proposal is intended to support recovery of the Indiana bat by improving conditions in and near hibernacula on the Forests, as provided for in the Forests' Land and Resource Management Plan.

During revision of the Ozark-St. Francis National Forests Land and Resource Management Plan (Forest Plan), informal consultation with the US Fish and Wildlife Service led to the development of standards for the management of Indiana bat habitat. These include, but are not limited to, standards to

- designate conservation zones within ¼ mile (primary zones) and 5 miles (secondary zones) of hibernacula (standard FW62);
- conduct landscape-scale analysis to determine commercial and non-commercial treatments needed to shift percent canopy closure toward optimal overstory density (standards FW47 and FW48);

- develop and maintain roosting and foraging habitat for this species through regulation and maintenance of canopy closure within the conservation zones (FW47 and FW48).
- protect Indiana bat hibernacula from human disturbance (standard FW63).

The required conservation zones have been designated as required by Forest Plan standard FW62. The current project represents implementation of the remaining three commitments made in the Forest Plan, with an emphasis on protecting hibernacula from human disturbance and restoring and maintaining roosting and foraging habitat. In other words, the proposal facilitates movement of the area toward attaining desired conditions identified in the Forest Plan.

Desired Conditions

Forest Plan desired conditions reflect the Indiana Bat Recovery Plan (USFWS 1983) and are consistent with conditions for the conservation of the Indiana bat documented in peer reviewed literature including but not limited to the Indiana Bat Draft Recovery Plan [Draft Recovery Plan (USFWS 2007)].

The Draft Recovery Plan (USFWS 2007) indicates habitat surrounding Indiana bat hibernacula must support the foraging and roosting needs of large numbers of bats during the fall swarming period. Important characteristics of the habitat are summarized below:

- Indiana bats primarily roost under the loose bark of dead trees. They will also roost in cavities and crevices as well as in live trees including, but not limited to shagbark hickory and white oaks > 20" diameter at breast height.
- The physical structure of the tree is more important than the species of tree. Standing, dead trees with loose bark are favored. Indiana bats have not been found in down trees.
- Roost trees are ephemeral (the bark sloughs off or the tree falls down) so a continuing supply is needed. Natural and human caused disturbance such as timber harvest, fire and storm damage can create suitable roost trees.
- During the summer season, Indiana bats use multiple roosts. They move from roost to roost probably in response to environmental factors and to locate alternate roosts in the case of loss of a roost tree.
- For most roosts, sunlight striking the bark is important. Most roosts are found in the open, at forest edges or high in a tree. During periods of high temperatures or rain, Indiana bats may roost in trees surrounded by canopy or in living white oaks and shaggy barked hickories.
- Indiana bats forage on flying aquatic and terrestrial insects among and adjacent to tree canopies. In uplands, terrestrial insects—especially moths—will predominate.

Specific desired conditions for roosting in foraging habitat of Indiana bats are outlined in the Forest Plan standards on pages 3-6 through 3-11. Forest-wide standards FW47 and FW48 respectively provide direction to maintain canopy closure between 60 and 80 percent (with average basal area

generally at site index plus 10) across 80 to 90 percent of primary conservation zone acres and between 50 to 70 percent (with average basal area generally at site index minus 10) across 80 to 90 percent of secondary conservation zone acres. In the secondary conservation zones a minimum of 60 percent of all forested acreage is to be maintained in nine inch or greater size classes. Of this total, about 40 percent will be trees in a mature condition (over 70 years old) and no more than 10 percent of the forested acreage of the secondary conservation zone will be in the early successional stage (0-10 years) at any time (FW68). Average snag density within the conservation zones is maintained at no less than 9 snags per acre (FW33). These conditions and density are comparable to those that existed before European settlement of the area and suppression of fire during the previous century [Spetich et al 2011; Nelson 2012; USDA 1999 General Technical Report SRS 35].

With respect to winter habitat, the desired condition is that hibernating populations of Indiana bats are protected from human disturbance.

Existing Conditions

Primary and secondary conservation zones for the Indiana bat have been identified as required by Forest Plan standard FW62:

- Primary conservation zones extend ¼ mile from each known hibernacula and total approximately 754 acres. All of the primary zone acres are managed by the Forest Service. The Federal Caves Resource Protection Act prohibits disclosure of endangered bat hibernacula; therefore, primary zones will not be shown on maps in this document.
- Secondary zones extend five miles to the north and west from each known hibernaculum and to the District's proclamation boundary to the south and west. Secondary conservation zones total approximately 86,451 acres of which approximately 66,397 acres are managed by the Forest Service; the remainder is in private ownership. Within the project area boundary approximately 98 percent of the National Forest Service acres and 72 percent of the private acres are forested.

Foraging habitat is provided throughout the project area, but is least cluttered in areas that have received recent thinning or burning treatments, and in areas that occur along the edges of more open habitats such as road and riparian corridors, glades, managed wildlife openings and range allotments.

Canopy cover across public and private ownership within the project area was estimated using remote sensing modeling and satellite data; the majority of the area (75 percent) was within the 70 to 100 percent range as shown in Figure 2. For the most part, areas closer to desired canopy conditions are coincident with privately owned land.

With the exception of Blanchard Springs Caverns, all caves on the District are under closure order. Despite this, recent evidence of illegal entry has been discovered. Four of the five extant (currently

used) Indiana bat hibernacula and a hibernaculum with historic use in the area lack gates to prevent illegal human entry during the hibernating period.

Summary (Purpose and need for action)

The proposed action has been developed in response to the discrepancy between the existing and desired conditions described above. Canopy closure on National Forest lands within the project area exceeds that which is optimal for the Indiana bat, and which is called for in the Forest Plan. In addition, there is a need to physically secure hibernacula from human disturbance during the hibernating period.

The purpose of this proposal is therefore to

- implement Forest Plan standards related to the management of summer and winter habitats for the endangered Indiana bat and
- create conditions more likely to provide for a continual supply of roost trees into the future.

More specifically, there is a need to:

- protect Indiana bat hibernacula from human disturbance;
- reduce and maintain canopy closure across primary and secondary conservation zones, and
- promote regeneration and recruitment to the overstory of oak, hickory and Shortleaf pine species.

Figure 1: Vicinity of the Indiana Bat Habitat Restoration Project Area

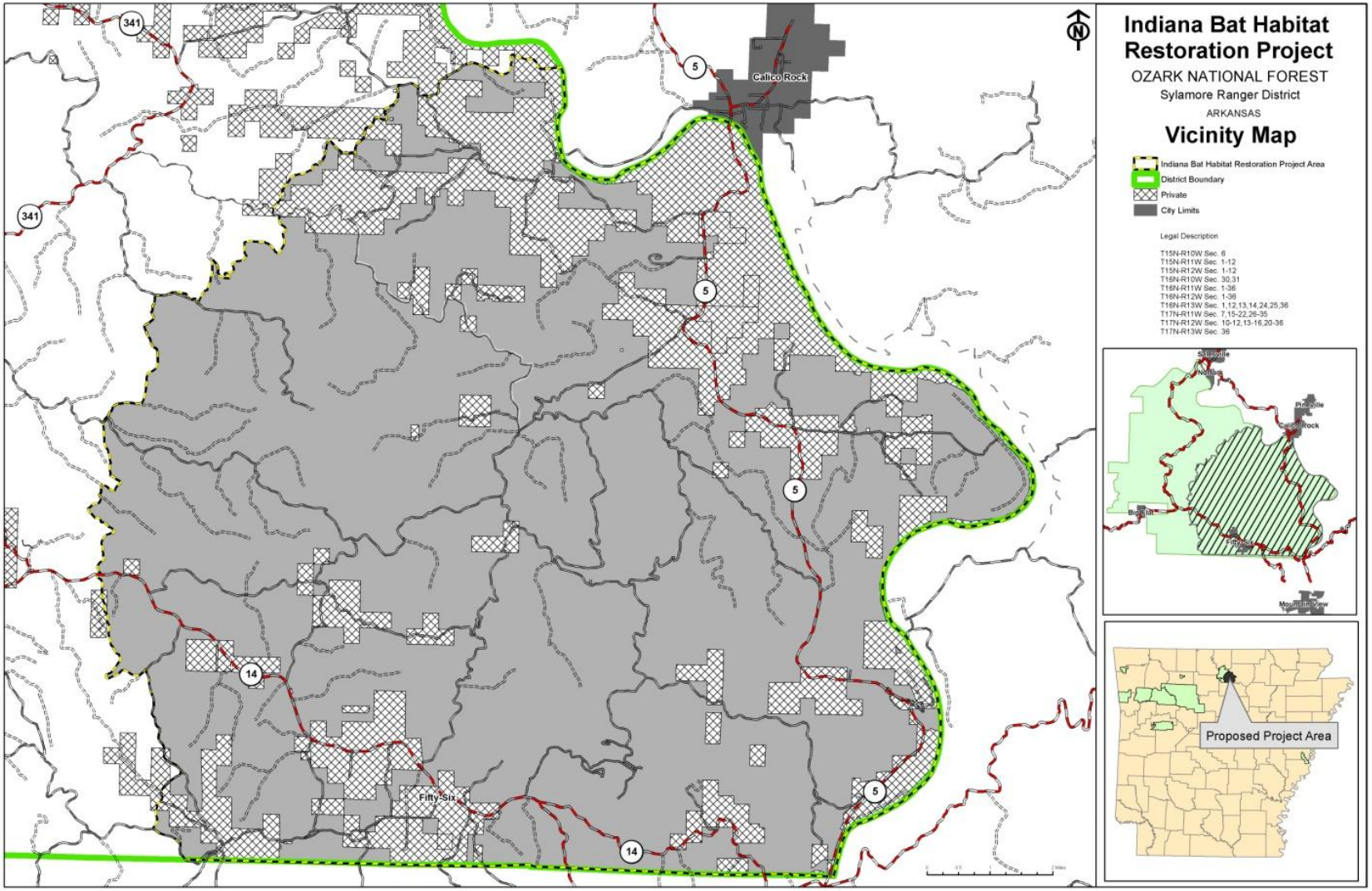
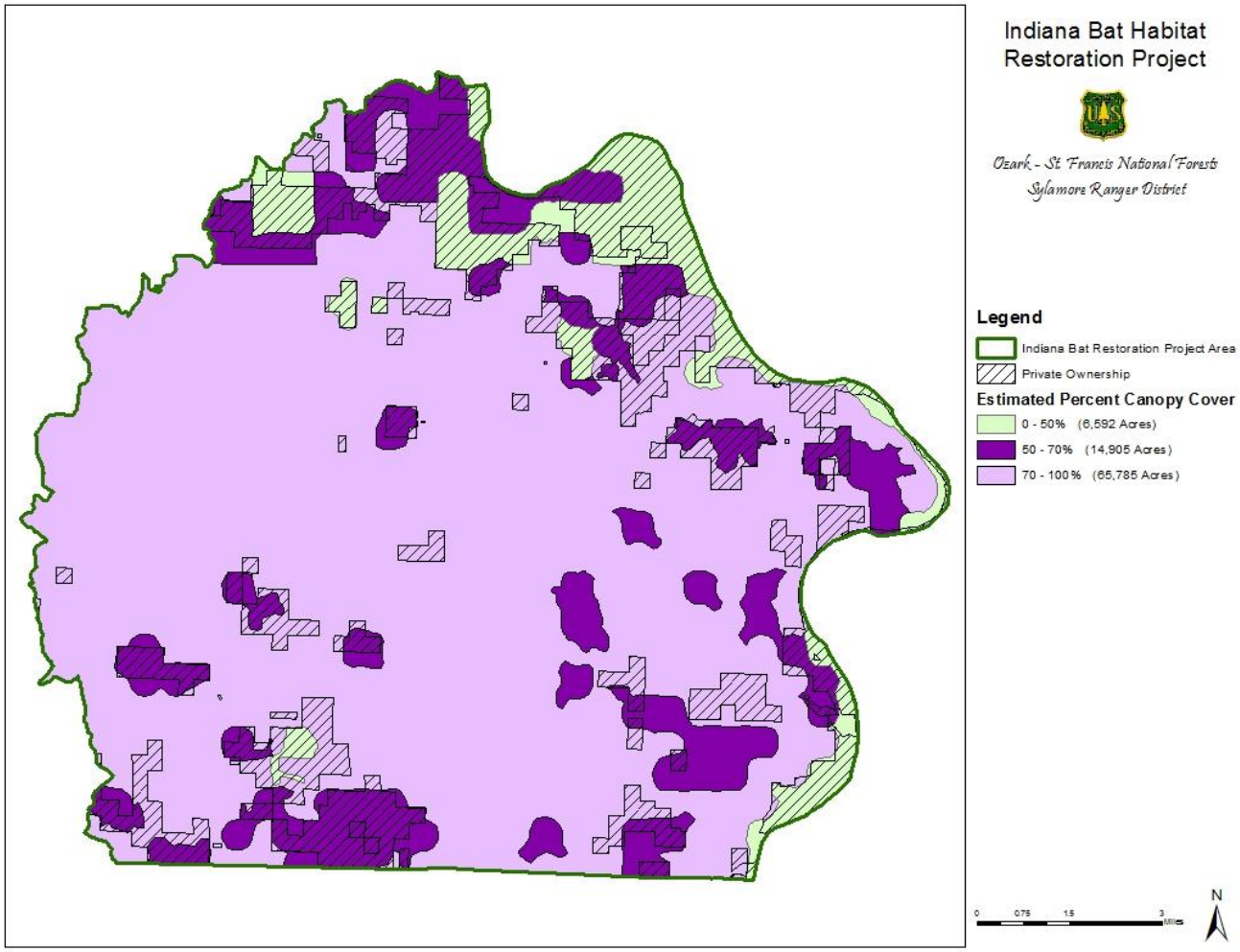


Figure 2: Estimated Percent Canopy Cover within the Indiana Bat Habitat Restoration Project Area



ALTERNATIVES

In an Environmental Assessment, alternatives serve to demonstrate tradeoffs associated with different approaches to attaining project objectives. In some cases, they may serve to avoid significant adverse environmental effects associated with the proposed action. To place the alternatives to the current proposal in context, it is useful to describe the nature and results of public involvement which has occurred so far.

Public Involvement

Schedule of Proposed Actions

This project was first listed on the Ozark-St. Francis National Forests Schedule of Proposed Actions during the 4th quarter of fiscal year 2011 (July 1, 2012 through September 30, 2011). It has been posted there since.

Scoping

Scoping establishes the range of actions, alternatives and effects to be considered in the Environmental Assessment. Scoping included notification via postal mail, posting a notice on the Forests' website and holding an Open House.

Mail and Website

On March 8, 2012, 779 notices summarizing the proposed action and seeking comments were mailed to:

- Native American Tribal leaders on the most current list of federally recognized Native American tribes with interest in the Ozark St. Francis National Forests and the AR Deputy State Historic Preservation Officer;
- Private landowners within and immediately adjacent to the project area. Private landowner names and addresses were obtained from the Geostor database on February 8, 2012;
- Retired Sylamore District employees; and
- Organizations, other agencies, and individuals who have expressed interest in projects involving these types of actions on the Sylamore Ranger District.

A public scoping notice was also posted on the Ozark St. Francis National Forests' website at that time.

Open House

On March 16, 2012 an Open House for this project was held at the Ozarka College Lecture Hall in Mountain View, AR. The scoping notice (above) included an invitation to the Open House. A public service announcement extending an invitation to the public was submitted to numerous media outlets. The Open House was staffed by the District Ranger, Sylamore-St. Francis Ranger District resource managers and other personnel, the Ozark-St. Francis National Forests' Planning

Biologist, and a member of the Ozark-St. Francis and Ouachita National Forests public affairs team. Eighteen individuals from the public attended the event.

Responses to Scoping (Issues)

To date twenty (21) responses to scoping have been received. The interdisciplinary team assigned to this project reviewed all of the comments. In general, the comments covered topics which were considered by the interdisciplinary team in developing the proposal. These included effects of on soil, water, air, climate, vegetation, federally listed and Regional Forester's sensitive species, management indicator species, migratory birds, aquatic communities, heritage resources, public access, scenery, the recreation experience, local communities and civil rights. Comments on these topics are addressed in the 'Environmental Consequences' section of this assessment, or through minor modifications to the proposal as described in the scoping letter. All comments received are provided in the project planning record.

Comments that prompted change of the scoped proposal are summarized below:

- A comment received in response to scoping included a suggestion to change the acres that may be burned per year from an annual implementation cap of 15,000 acres/year to an average of 15,000 acres/year. The person making this recommendation pointed out that operational barriers such as weather and staffing conditions could occur in any given year and may result in not meeting the set objective; he went on to state that an annual cap prevents the potential to burn those acres in subsequent years. The suggested change was incorporated.
- Comments suggesting the effects of proposed management activities on prey of Indiana bats (flying insects such as moths, butterflies and beetles) be examined were also received. This is relevant to the decision to be made and will be addressed in this Environmental Assessment.
- Some interdisciplinary team members felt the description of non-native invasive plant treatments presented in the scoping letter should be clarified. Non-native invasive plants would be treated with herbicide on up to 1,100 acres/year. Timber stand improvement, wildlife stand improvement and prescribed burning operations may simultaneously remove non-native invasive plants within the treatment units.

One issue identified from public comment—the extent of herbicide use proposed—led to the development of a reduced herbicide alternative. While the interdisciplinary team believes that the potential effects of the proposed herbicide use are well-understood, the team and the District Ranger also believe that the public would benefit from disclosure of the differences between using herbicides to both control non-native invasive plant species and accomplish timber stand improvement, site preparation and wildlife stand improvement; and using herbicides solely to control non-native invasive plant species.

Summary of Alternatives

The alternatives developed for this project are summarized below; **more detailed descriptions of Alternatives 2 and 3 are provided in Appendix A of this Environmental Assessment.**

Treatments would be implemented in accord with all Forest Plan requirements and in accord with all relevant federal, state and local laws and regulations as well as State of Arkansas Best Management Practices (2002), the AR Forestry Commission's Smoke Management Program (2007), Forest Service Manual requirements and Forest Service Handbook guidance. Each year a program of work will be developed with District and Supervisor's Office resource specialists. It will be posted on the Forests' website.

For this project, limits on the number of acres that can be treated annually, additional design criteria, monitoring requirements and impact thresholds were also put in place to further ensure the potential for negative impacts are properly understood and minimized. Annual implementation caps are based on the anticipated resources for implementation of an action alternative; that is, on the District's capacity to do so when fully staffed.

The action alternatives include triggers for change in management. These are described in Appendix A and in Table 2.

Alternative 1 - No Action

Under Alternative 1, no new action to implement Forest Plan standards regarding canopy closure for Indiana bat would be taken at this time, nor would hibernacula be gated. Other, unrelated actions could occur, as listed in the Schedule of Proposed Actions. Previously approved projects would continue until the planned actions were complete.

Alternative 2 - Proposed Action

Under Alternative 2, the proposal as modified in response to scoping (Table 3 and Appendix A) would be implemented. Treatments shall be prescribed as field examinations are completed or as monitoring results trigger pre-determined responses. Herbicides would be used to control non-native invasive plant infestations and to implement timber stand improvement, site preparation and wildlife stand improvement actions. More specifically, the following actions are proposed:

- Commercial timber harvests (no more than 3,500 acres/year) and associated activities to extract timber which include:
    - construction of temporary roads, log landings and skid trails where needed;
    - road reconstruction (no more than 10 miles/year), and
    - purchaser road maintenance (no more than 15 miles/year);
- Reforestation (no more than 700 acres/year);
- Site preparation and timber stand improvement activities (no more than 2,000 acres/year of mechanical, manual, chemical or burning treatments combined);

- Wildlife stand improvement activities (no more than 2,000 acres/year of mechanical, manual, chemical or burning treatments combined);
- Prescribed burning (an average of 15,000 acres/year for all purposes) with no more than 2.0 miles of new mechanically constructed prescribed fire containment line/year;
- Mechanical treatments (no more than 600 acres/year);
- Treatment of non-native invasive plant species (no more than 1,100 acres/year with chemical herbicide);
- Cave gates would be installed on and/or fencing would be installed around extant (currently used) hibernacula, an historic hibernaculum if use resumes as well as any other caves if use as a hibernacula is discovered.
- Monitoring and reporting

The common names of the chemical herbicides proposed for use are glyphosate, triclopyr (amine and ester formulations), and imazapyr. Citrus based surfactant or vegetable oil carrier may be added to increase herbicide efficiency for treatments outside streamside management zones. The use of imazapyr would be limited to the treatment of non-native invasive plant infestations outside streamside management zones.

Alternative 3 - Reduced Herbicide Use

Under Alternative 3, gating or fencing hibernacula, harvests and associated actions, prescribed burning and associated mechanical construction of prescribed fire containment line, mechanical treatments, treatment of non-native invasive plant infestations, monitoring and reporting would be as proposed for Alternative 2.

To accomplish timber stand improvement, site preparation and wildlife stand improvement work, only manual, mechanical and prescribed burning treatments would be used. Because these types of treatments typically remove only the above-ground portion of targeted stems, re-sprouting will occur. It is anticipated, therefore, that these treatments will need to be repeated until the desired results are realized. The frequency at which these treatments would be repeated will depend on the species treated, site conditions and treatment objectives. Annually, no more than 4,000 acres/year of timber stand improvement and site preparation and no more than 4,000 acres of wildlife habitat improvement treatments would be conducted. In other words, because of the need for repeat treatments, this acreage would replace the 2,000 acres of timber stand improvement and 2,000 acres of wildlife habitat improvement treated with herbicides in Alternative 2.

Table 1: Conditions for Treatments

Proposed Activity	Conditions for Treatment
Regeneration harvest (seed tree or shelterwood harvests)	Prescribe regeneration harvests in accord with requirements outlined in 36 CFR 219.11, FSM 2400 Chapter 2470, and the Forest Plan. This treatment may only be applied where • sustained slopes do not exceed 35% and the unit is within ½ mile of an existing road. • No more than 10% of the conservation zones would be in the 0-10 year age class following the harvest And • Stand age is a minimum of 140 years and the stand can be restocked within 5 years following final removal Or • 50 % or more of the trees in a stand are damaged by storm, wildfire, insects or disease.
Intermediate Commercial Thinning	In mature stands where sustained slopes do not exceed 35% and the unit is within ½ mile of an existing road remove overstory trees to reduce basal area to site index minus 10 in the secondary zone and site index plus 10 in the primary zone provided the area. Single tree or group selection cuts may be used where appropriate to protect sensitive resources or scenic value.
Sanitation harvests	Where 50% or more of a stand is impacted by disease or insect infestation, to remove the trees in the affected area and create a buffer between it and healthy surrounding stands.
Salvage harvests	Where 50% or more of a stand is damaged by wind, ice or fire, remove dead, dying or damaged trees.
Purchaser Road Maintenance or Reconstruction to Extract Harvested Timber	As outlined in FSH 2409.15 § 51.51, FSH 2409.18 §33.2, 33.3 and 43.43, FSH 7709.59 § 62.1 and 63.41.
Construction of log landings and skid trails followed by disking, seeding and blocking of those installations when harvest activities are completed.	Locations of these installations will be determined by topography, soils and specialist input regarding sensitive resources

Table 1: Conditions for Treatments

Proposed Activity	Conditions for Treatment
Construction of temporary roads followed by disking, seeding and blocking of those installations when harvest activities are completed.	As outlined in FSH 2409.15 § 51.8 to provide access to landings with the least impact on the natural resource where the grade does not exceed 20% for lengths more than 200 feet and the total length does not exceed 0.25 mile.

Prescribed Burning	• Where needed to
	  • improve or maintain fire regime condition class
	  • reduce litter depth or remove slash to support establishment of oak-hickory regeneration.
	  • reduce midstory vegetation competing with advanced oak-hickory regeneration.
	• Available fuels would be 1 ton per acre or greater
	• Use growing season burns when dormant season burns are not producing desired results.
	• At least one growing season burn should be applied each 3rd rotation

Mechanical construction of fire containment line followed by rehabilitation activities when burning operations are completed	Where existing roads or other natural barriers do not exist such as between public and private ownerships.
Mechanical Treatments	• to modify fuel structure and fire behavior prior to a prescribed burn –most likely in the wildland urban interface or to reduce jackpot (piled) fuels • to remove woody encroachment from open habitat types
Site preparation with herbicide	To remove species that compete with regeneration of overstory species
Site preparation with mechanical, manual or prescribed burning treatments	To prepare the seedbed and to provide young oak-hickory regeneration time to grow without competition for sunlight.
Timber stand improvement with herbicide, manual, mechanical or prescribed burning treatments combined	To reduce competition with oak-hickory regeneration and promote its recruitment to the overstory • In stands up to 10 years old, maintain 500 – 600

Table 1: Conditions for Treatments

Proposed Activity	Conditions for Treatment
	trees/acre of oak-hickory regeneration. • In stands older than 10 years, maintain 300 – 400 trees/acre of advanced oak-hickory regeneration.
Timber stand improvement with manual, mechanical or prescribed burning treatments combined	To reduce competition with oak-hickory regeneration and to promote its recruitment to the overstory • In stands up to 10 years old, maintain 500 – 600 trees/acre of oak-hickory regeneration. • In stands older than 10 years, maintain 300 – 400 trees/acre of advanced oak-hickory regeneration.
Wildlife stand improvement with herbicide, manual, mechanical or prescribed burning treatments combined to improve growing conditions for hard and soft mast producing trees, to increase structural diversity and to create den or roost trees.	Where needed to reduce competition with regeneration of hard and soft mast producing trees • In stand up to 10 years old, maintain 500 – 600 trees/acre of desirable overstory regeneration. • In stands older than 10 years, maintain 300 – 400 trees/acre of desirable overstory species. Use growing season prescribed burning to reduce competition with advanced oak-hickory regeneration. Use dormant season prescribed burning to reduce litter depth and promote establishment of oak-hickory regeneration, and promote growth of grasses, forbs and flowering plants. Create snags where density does not meet Forest Plan standard minimum requirements by girdling trees with herbicide or with chainsaws. Implement non-commercial cut and leave treatments to attain desired project canopy closure objectives. Thin to a basal area of site index plus 10 in primary zones or site index minus 10 in secondary zones.
Wildlife stand improvement with manual, mechanical or prescribed burning treatments combined to improve growing conditions for hard and soft mast producing trees, to increase structural diversity and to create den or roost trees.	Where needed to reduce competition with regeneration of hard and soft mast producing trees • In stand up to 10 years old, maintain 500 – 600 trees/acre of desirable regeneration. • In stands older than 10 years, maintain 300 – 400 trees/acre of desirable species. Use growing season prescribed burning to reduce competition with advanced oak-hickory regeneration or to

Table 1: Conditions for Treatments

Proposed Activity	Conditions for Treatment
	remove woody encroachment from open habitats. Use dormant season prescribed burning to reduce litter depth and promote establishment of oak-hickory regeneration, and promote growth of grasses, forbs and flowering plants. Create snags where density does not meet Forest Plan standard minimum requirements by girdling trees with chainsaws. Implement non-commercial cut and leave treatments to attain desired project canopy closure objectives. Thin to a basal area of site index plus 10 in primary zones or site index minus 10 in secondary zones.
Treatment of non-native invasive plant infestations with herbicide	If non-native invasive plant infestations are in or adjacent to units receiving ground disturbing actions or actions that will result in canopy gaps: *USDA Forest Service National Forest System Data Recording Protocols and Requirements for Invasive Species Survey, Inventory and Treatment* (2012) will be followed (see Appendix H). *Nonnative Invasive Plants of Southern Forests: A Field Guide for Identification and Control (SRS-62)* will also be referenced. Infestations will be prioritized for treatment using the Forests' Threat Decision Matrix for Non-native invasive plants (see Appendix I). Rates of herbicide and citrus based surfactant or vegetable oil carrier will be as directed by the herbicide label. The species, extent of the infestation, potential for impacts of the species, site quality, difficulty of control and establishment of replacement species will all be considered.
Slash disposal treatments	As described in Appendix A
Adaptive Management Monitoring	As described in Appendix A and summarized below in

Table 1: Conditions for Treatments

Proposed Activity	Conditions for Treatment
to determine the effects of actions to 1. reduce canopy closure 2. promote establishment of regeneration of dominant overstory species in regeneration units, 3. to ensure design criteria to mitigate the potential for unintended contamination of streams with herbicide are working as predicted 4. to ensure treatments to control the spread of non-native invasive plant infestations from project actions are working as predicted.	Table 2.

Table 2. Adaptive Management Monitoring Summary

Monitoring Activity	Purpose	Protocol	Frequency	Minimum Compliance	Action to be taken if results do not meet minimum compliance levels or if measures to mitigate impacts do not work as planned
Canopy Closure	Identify needed treatments, locations and effectiveness of treatments	Appendix A: spherical densitometer	During full leaf period before treatments are implemented and after activities affecting canopy closure are completed	Per Forest Plan standards FW47 and FW48	If canopy closure exceeds desired levels outlined in FW47 and FW48: a. Return and thin again b. Return and burn/thin again c. Use option a or b the next time a treatment is scheduled. Apply what was learned to prescriptions for the next area to be entered.
Non-native invasive plant infestations	Prioritize treatments and locations in accord with the Treatment Matrix in Appendix I	USDA Forest Service National Forest System Data Recording Protocols and Requirements for Invasive Species Survey, Inventory, and Treatment	Within two months of treatment or after green up if the treatment was made near the end of the growing season.	Will depend on the species and extent of the initial infestation.	Retreat with the same chemical or with one of the other herbicides selected for this project if more than 50% of the treated stems do not appear to have been affected. Continue monitoring. If all the herbicides proposed for use do not adequately control a non-native invasive plant species, a new National Environmental Policy Act analysis

Table 2. Adaptive Management Monitoring Summary

Monitoring Activity	Purpose	Protocol	Frequency	Minimum Compliance	Action to be taken if results do not meet minimum compliance levels or if measures to mitigate impacts do not work as planned
					will be initiated to examine other treatment options.
Gates on hibernacula	Identify harm to bats or changes in microclimate	To be developed cooperatively with FWS and interested Tribal Nations	Pre and Post Gating	No impacts to bats	If bats are being harmed or if changes to microclimate are observed, remove the gate and try a different gate design.
Stream Contamination with herbicides	Ensure that measures to protect streams from contamination are working	2007 Ozark-St. Francis National Forests Herbicide Monitoring Plan	after application	No herbicide detected	Glyphosate has a maximum contaminant level of 0.7 milligrams per liter for drinking water established by the Environmental Protection Agency. Imazapyr and triclopyr do not have established drinking water standards, but imazapyr has a level of concern of 87,000 parts per billion for the general US and 25,000 parts per billion for children age 1-2 years. Triclopyr has a reference dose of 0.05 milligrams/kilogram/day for women of child bearing age. The reference dose for others is 1 mg/kg/day. a) If detected at levels below ½ these values, an investigation will be conducted to discern the possible reason for the contamination. b) If the level of detection is at or near ½ the recognized standard, the

Table 2. Adaptive Management Monitoring Summary

Monitoring Activity	Purpose	Protocol	Frequency	Minimum Compliance	Action to be taken if results do not meet minimum compliance levels or if measures to mitigate impacts do not work as planned
					reduced herbicide alternative will be implemented from that point. If the reduced herbicide alternative was being implemented when the contamination was discovered, the project will be outside the bounds of analysis and decision and a new National Environmental Policy Act analysis must be completed.
Regeneration	Ensure minimum stocking requirements are met in regenerating stands	FSH, FSM and Forest Plan direction (FW11)	1st and 3rd years following regeneration harvest	Forest Plan stocking levels	Interplant

Table 3: Comparison of Activities Proposed for Each Developed Alternative

Proposed Activity	Alternative 1 Acres or Miles/Year Beyond Those Previously Approved in the Area	Alternative 2 Acres or Miles/Year Beyond Those Previously Approved in the Area	Alternative 3 Acres or Miles/Year Beyond Those Previously Approved in the Area
Commercial timber harvest to include • Intermediate thinning • Regeneration harvest (seed tree or Shelterwood harvests) • Single tree or group selection harvests • Sanitation harvests • Salvage harvests	None	No more than 3,500 acres total	No more than 3,500 acres total
Purchaser Road Maintenance to Extract Harvested Timber	None	No more than 15 miles total	No more than 15 miles total
Road Reconstruction to Extract Harvested Timber	None	No more than 10 miles total	No more than 10 miles total
Construction of log landings and skid trails followed by disking, seeding and blocking those installations when harvest activities are completed.	None	As needed to extract harvested timber	As needed to extract harvested timber
Construction of temporary roads followed by obliteration of those installations when harvest activities are completed.	None	Up to 3.5 miles total	Up to 3.5 miles total
Prescribed Burning (dormant or growing season)	None	An average of 15,000 acres/year (for all treatment purposes combined)	An average of 15,000 acres/year (for all treatment purposes combined)
Mechanical construction of fire containment line followed by	None	No more than 2.0 miles total	No more than 2.0 miles total

Table 3: Comparison of Activities Proposed for Each Developed Alternative

Proposed Activity	Alternative 1 Acres or Miles/Year Beyond Those Previously Approved in the Area	Alternative 2 Acres or Miles/Year Beyond Those Previously Approved in the Area	Alternative 3 Acres or Miles/Year Beyond Those Previously Approved in the Area
rehabilitation activities when burning operations are completed			
Mechanical Treatments	None	No more than 600 acres for all treatments combined	No more than 600 acres for all treatments combined
Timber stand improvement and site preparation with herbicide, manual, mechanical or prescribed burning treatments combined	None	No more than 2,000 acres total	---
Timber stand improvement and site preparation with mechanical, manual or prescribed burning treatments combined	None	---	No more than 4,000 acres total
Wildlife stand improvement with herbicide, mechanical, manual or prescribed burning treatments combined	None	No more than 2,000 acres total	---
Wildlife stand improvement with mechanical, manual or prescribed burning treatments combined	None	---	No more than 4,000 acres total
Treatment of non-native invasive plant infestations with herbicide	None	No more than 1,100 acres	No more than 1,100 acres
Slash disposal treatments	None	Where appropriate to mitigate effects to travel routes and other areas with heavy public use	Where appropriate to mitigate effects to travel routes and other areas with heavy public use
Monitoring to determine the effects of	None	Required.	Required.

Table 3: Comparison of Activities Proposed for Each Developed Alternative

Proposed Activity	Alternative 1 Acres or Miles/Year Beyond Those Previously Approved in the Area	Alternative 2 Acres or Miles/Year Beyond Those Previously Approved in the Area	Alternative 3 Acres or Miles/Year Beyond Those Previously Approved in the Area
actions to reduce canopy closure, to promote regeneration of dominant overstory species in regeneration units, to ensure gating does not cause harm or change cave microclimate conditions, to ensure design criteria to mitigate the potential for unintended contamination of streams with herbicide or spread of non-native invasive plants from project actions are working as predicted.		Triggers for change are outlined in Appendix A and in Table 2	Triggers for change are outlined in Appendix A and in Table 2
Monitoring Oversight and Report Preparation	n/a	Required; duty to be assigned by the District Ranger	Required; duty to be assigned by the District Ranger
Periodic Reporting of Monitoring Results	n/a	Annually report acres of each treatment implemented, acres planned for implementation in the coming fiscal year, herbicide monitoring results Every 3 to 5 years report results of canopy closure monitoring,	Annually report acres of each treatment implemented, acres planned for implementation in the coming fiscal year, herbicide monitoring results Every 3 to 5 years report results of canopy closure monitoring

Alternatives Considered But Eliminated from Further Development
The interdisciplinary team considered twelve additional alternatives to the proposed action and eliminated them from further study. Public scoping responses included suggestions to consider:

- three (3) alternatives that would reduce or eliminate the use of prescribed fire,
- a no herbicide alternative,
- an alternative that would limit harvest to the single tree selection method,
- an alternative limited to gating hibernacula,
- an alternative that creates no new open areas,
- an alternative utilizing recognized conservation methods;
- an alternative that excludes the Clifty Canyon Special Interest Area from the project area;
- an alternative that includes actions to control feral hogs or modification of the proposed action to do so;
- an alternative that includes activities to maintain constructed ponds or modification of the proposed action to do so; and
- an alternative that includes activities to manage public access or modification of the proposed action to do so.

Reduce or Eliminate the Use of Prescribed Fire:
The Interdisciplinary Team considered three (3) alternatives to the proposed action that would either eliminate or reduce the use of prescribed fire. They included a no-burning alternative, an alternative that limited burning to glades and an alternative that limited burning to existing open fields.

Research indicates fire played a role in the development of the Ozark National Forest's ecosystem (Spetich et al 2011; Dey and Fan 2009; Nelson 2012), and is therefore an important component of natural processes in the project area. While prescribed fire could result in a violation of National Ambient Air Quality Standards, Forest Plan standards, National Forest smoke management policies (FSM 5144) and the Arkansas Forestry Commission's Smoke Management Program (available at http://forestry.arkansas.gov/Services/KidsTeachersEveryone/Documents/ArkansasVSMG.pdf) reduce the potential for negative impacts from smoke. We are not aware of any scientific data that suggests violations of National Ambient Air Quality Standards or other quality problems that are more likely with this proposal. The impacts of prescribed burning as proposed are addressed in the "Environmental Consequences" section of this Environmental Assessment.

No Herbicides
Although impacts of herbicides on human health or natural resources are of concern to the public, scientific data indicate that there is no serious risk from the use of herbicides as proposed here.

Manufacturer's label requirements will be followed. Herbicide labels reflect numerous scientific studies and regulatory reviews generated by the Environmental Protection Agency's registration process, which provides assurance that potential benefits of use outweigh any potential risks and that, when used according to label directions, the herbicide will not cause unreasonable adverse effects on humans, fish and wildlife or the environment.

Human Health and Ecological Risk Assessments (risk assessments) have been completed for the herbicides proposed for use. In these documents, the process of risk assessment is used to quantitatively evaluate the probability (i.e. risk) that a pesticide use might pose harm to humans or other species in the environment. It is the same assessment process used for regulation of allowable residues of pesticides in food, as well as safety evaluations of medicines, cosmetics, and other chemicals. The current risk assessments which include associated worksheets for glyphosate, triclopyr and imazapyr were prepared in 2011 and indicate that use of these chemicals as proposed poses no plausible basis for concern to the human or natural environments (USDA FS 2011a; USDA 2011b; USDA FS 2011c).

Furthermore, Forest Plan standards mitigate the potential for unintended impacts to the human and natural environments with regard to herbicide application. Among other requirements, the Forest Plan requires utilization of minimum buffer zones and other restrictions near karst features, streams, water intake locations, and private land. The Forest Plan does not provide for herbicide applications within karst management zones. Within streamside management zones, only formulations of herbicides labeled for aquatic and terrestrial use may be used to treat non-native invasive plants. Herbicide would not be used to implement timber stand or wildlife stand improvement activities within streamside management zones.

Finally, specific details of the proposal further mitigate the potential impacts.

- Limits have been set on the number of acres that may be treated annually with herbicide; if herbicide is applied more than once on an acre, each application will count as an acre treated.
- All aspects of herbicide use will be supervised.
- The majority of treatments would be selective and non-contiguous meaning herbicide will not be broadcast. It will be applied directly to each targeted stem.
- Treated areas will be separated by untreated areas.
- Only citrus based surfactant or vegetable oil carrier will be used to increase the efficacy of applications, thus reducing the need to use higher rates or to repeat treatments to achieve the same results.
- Surfactant will not be used in streamside management zones.
- Herbicide will not be applied directly to soil or water, and it will not be applied aerially.
- Large drop size and low pressure will reduce potential for drift.

Notwithstanding the above, the interdisciplinary team and Ranger recognize that there is public concern about application of chemical herbicides. To display the tradeoffs that are associated with foregoing the use of herbicides, an alternative (Alternative 3) was developed that does not use herbicides for timber stand improvement, site preparation and wildlife habitat improvement.

Limit Harvest Methods to Single Tree Selection Only
The interdisciplinary team considered an alternative to limit harvest to the single tree selection only. Limiting harvest to this method would not create large enough canopy gaps across enough of the project area to move the area toward desired conditions (Dey and Fan 2009). The proposed action does not preclude the use of this harvest method and it would be prescribed if appropriate.

Limit Action to Gating Hibernacula
The interdisciplinary team considered an alternative to only gate hibernacula. However, during revision of the Forest Plan, informal consultation with the US Fish and Wildlife Service led to the development of standards for the management of Indiana bat habitats (described in "Desired Conditions"). An alternative that only involves gating hibernacula will not satisfy Forest Plan requirements to improve roosting and foraging habitat for the Indiana bat and would be a breach of the Ozark-St. Francis National Forests' commitments to US Fish and Wildlife Service.

Have No Open Areas
Indiana bats forage for insect prey in canopy gaps, within openings, edge habitat and transitional habitat between openings and forested areas. Maintaining an open habitat component is required by the Forest Plan. Under the proposed action, foraging habitat for the Indiana bat would be enhanced through the removal of encroaching woody vegetation from open habitat types such as glades, existing managed wildlife openings, and range allotments but it does not propose creation of new areas to be managed as such.

Limit Actions to Recognized Conservation Methods Only
This comment [Larson, project planning record] did not identify the conservation methods or the authority that recognizes them. Actions proposed here were developed through informal consultation with the US Fish and Wildlife Service, and are consistent with threats and responses identified in the original and revised Recovery Plans. More generally, the activities proposed are recognized restoration techniques that are used to return degraded, damaged or destroyed ecosystems to a state that is within a historical range of variability. Based on experience and a review of scientific literature, we can predict with a reasonable degree of certainty what the impacts (positive and negative) of implementing the proposed actions.

Exclude the Clifty Canyon Special Interest Area from the Project Area
A response to scoping [Woltjen, project planning record] suggested a separate environmental analysis be prepared for management actions within the Clifty Canyon Special Interest Area.

Clifty Canyon occurs within the secondary conservation zone for the Indiana bat. The Forest Plan provides direction for management within Special Interest Areas that will be followed.

Include Activities to Control Feral Hogs or Modify the Proposed Action to Include Them
The interdisciplinary team discussed modifying the proposed action to include or developing an alternative that includes management for feral hogs. Managing feral hogs is the subject of on-going discussions regarding appropriate strategies and techniques that will result in a comprehensive management proposal. Control of feral hogs is outside the scope of this project.

Include Activities to Maintain Constructed Ponds or Modify the Proposed Action to Include Them
In addition to constructed ponds, the project area has numerous natural water sources (springs, seeps, streams). Actions to maintain constructed ponds are outside the scope of the project's objectives to regulate and maintain overstory density and to ensure roost trees are available for the future.

Include Activities to Manage Public Access or Modify the Proposed Action to Do So
Changes to the District's transportation system (system road closure and system road decommissioning), obliteration of unauthorized travel routes and actions to limit access by horseback are outside the scope of this project. Therefore the proposed action will not be modified to include these actions; neither will an alternative that includes actions to manage road access be developed.

Adaptive Management

Adaptive management stems from the recognition that knowledge about a natural resource system is sometimes uncertain (36 CFR 220.3). To quote from the regulations:

"A system of management practices based on clearly identified intended outcomes and monitoring to determine if management actions are meeting those outcomes; and, if not, to facilitate management changes that will best ensure that those outcomes are met or re-evaluated."

In the case of the current proposal, there is an element of uncertainty that lends itself to an adaptive approach. Alternative 2 uses herbicide to accomplish timber stand improvement, site preparation, wildlife stand improvement and non-native invasive plant treatments. Alternative 3 limits the use of herbicide to treating non-native invasive plants, and has higher levels of manual, mechanical or prescribed burning treatments. Alternative 3 *may* result in a greater use of prescribed fire during the growing season than Alternative 2 to reduce competition between regenerating overstory species.

The degree to which that may happen is unknown at this time, and there is limited recent experience with growing season burning on the Sylamore Ranger District. Therefore, the interdisciplinary team and District Ranger may opt to adapt treatments, within the scope of the analyzed alternatives, during the anticipated 12-year life of the decision. That is, if Alternative 3 is selected, and the effects of growing season burning exceed those disclosed in this analysis, or if repeat treatments make it impossible to achieve area-wide canopy objectives (because of treatment limits), then Alternative 2 would be adopted. Conversely, if Alternative 2 is selected, and effects of herbicides exceed those disclosed in this analysis, then Alternative 3 would be adopted. Finally, if a combination alternative were selected (some areas treated in accordance with Alternative 2, and some in accordance with Alternative 3), then over time the more effective/less impacting approach would be used in place of the less effective/more impacting.

Decision Framework

Informed by the analyses summarized in this document, and included in detail in the project record, the District Ranger of the Sylamore and St. Francis Districts, Ozark-St. Francis National Forests, will decide whether there is a significant environmental effect associated with actions to implement Forest Plan standards for Indiana bat habitat. In the event that a significant environmental effect is identified, an Environmental Impact Statement will be prepared. If no significant effect is identified, the District Ranger will decide:

- Which of the analyzed alternatives to select and implement,
- Whether the selected alternative should be modified in response to comments,
- Whether to implement an adaptive management decision that alters the use of herbicides in response to monitoring, and if so, the conditions that will result in alteration.

The decision and rationale will be documented in a Finding of No Significant Impact, and Decision Notice, or in a Decision Notice that elects to prepare an Environmental Impact Statement. In commenting on this analysis, substantive comments that identify effects likely to be encountered in the specific project area, identify key resources to be monitored, and discuss appropriate circumstances for adapting the decision would be appreciated.

ENVIRONMENTAL CONSEQUENCES

This section summarizes the potentially affected physical, biological and human environments of the project area and the potential changes to those environments due to implementation of the alternatives. As required by 36 CFR 219.35, the best available science was considered in preparing this Environmental Assessment.

The project planning record demonstrates a thorough review of relevant scientific information, consideration of responsible opposing views, and where appropriate, the acknowledgment of incomplete or unavailable information, scientific uncertainty, and risk. The project planning record is located at the Sylamore Ranger District Office of the Ozark-St. Francis National Forests in Mountain View, AR. Forest-wide monitoring data are archived at the Ozark-St. Francis National Forests' Supervisor' Office in Russellville, AR.

Forest Database

Layers of the Forest's geographic information system database were created using various tools and methods over time. Different database layers were used to prepare this analysis. When overlapped, these layers do not always align perfectly. Acres or percentages provided for one resource area may therefore, vary slightly from those presented for another.

Effects Analysis Area and Timeframe

This is a landscape level project with treatments that will be implemented at smaller scales over a 12 year period to incrementally affect changes to the landscape while minimizing the potential extent of negative effects. A longer timeframe than that to which most are typically accustomed for implementation is needed to better assess the effect of some treatments at meeting project objectives (which may not be realized for one to five growing seasons after that treatment is completed). Unless indicated otherwise, analysis areas for direct, indirect and cumulative effects shall be the project area boundary, and the timeframe for this analysis shall be 12 years.

Incorporation by Reference

The following are incorporated by reference:

- The Revised Ozark-St. Francis National Forests' Land and Resource Management Plan (2005)
- The Final Environmental Impact Statement for the Revised Ozark-St. Francis National Forests' Land and Resource Management Plan (2005)
- Glyphosate: Human Health and Ecological Risk Assessment Final Report and Appendices (2011) SERA TR 052-22-03b and SERA TR-052-22-03a-App
- Imazapyr: Human Health and Ecological Risk Assessment Final Report. (2011) SERA TR 052-29-03a.
- Triclopyr: Human Health and Ecological Risk Assessment Final Report and Appendices (2011) SERA TR 052-25-03a and SERA TR-052-25-03a-App.

- Arkansas Forestry Commission's Best Management Practices (2002)
- Arkansas Forestry Commission's Smoke Management Program (2007)
- USDA Forest Service National Forest System Data Recording Protocols and Requirements for Invasive Species Survey, Inventory and Treatment (2012)
- Ozark-St. Francis National Forests Threat Decision Matrix for Non-native Invasive Plant Species
- Ozark-St. Francis National Forests Herbicide Monitoring Plan
- TACCIMO Model Outputs for this project
- WRACE Model Outputs for this project
- The Indiana Bat Environmental Assessment Heritage Resource Inventory Report (#12-10-01-01)
- The Biological Evaluation prepared for this project (2013)
- The Regional Forester's Sensitive Listed Species Assessment prepared for this project (2013)
- The Draft Indiana Bat Recovery Plan (2007)
- Nonnative Invasive Plants of Southern Forests: A Field Guide for Identification and Control. Gen. Tech. Rep. SRS-62.

Management Areas

The 1982 planning regulations guiding implementation of the National Forest Management Act (NFMA) call for lands and waters to be assigned to "management areas" (36 CFR 219.11). These are areas within a National Forest having desired conditions, suitable uses, management objectives, and design criteria in common. Twenty-five (25) management areas are identified for the Ozark-St. Francis National Forests and are delineated by the Forest Plan. National Forest System lands of the project area fall within eight (8) of these as shown on the Management Area map in Figure 2 and as listed below in Table 4. Management Area standards outlined in the Forest Plan will be applied during project implementation.

Table 4: Management Areas within the Indiana Bat Habitat Restoration Project Area Boundary

Management Area	Described in the Forest Plan on pages	Approximate National Forest Acres within the Project Area
1.C: Designated Wild and Scenic Rivers	2-35 through 2-37	3,765
1.E: Experimental Forests	2-40 and 2-41	4,275
1.G: Special Interest Areas	2-43 and 2-44	5,936[1]
1.H: Scenic Byway Corridors	2-45 and 2-46	4,803
2.C: Developed Recreation Areas	2-50 through 2-52	650
3.C: Mixed Forest	2-61 and 2-62	46,993
3.I: Riparian Corridors	2-71 through 2-76	367
3.J: Pastures[2] and Large Wildlife Openings	2-76 and 2-77	330

[1]1,922 acres within the Clifty Canyon Special Interest Area are currently managed as a Roadless Area.
[2]Range allotments totaling approximately 246 acres occur within other Management Areas.

Congressionally Designated Areas

The project area does not contain any acreage congressionally designated as a wilderness, a wilderness study area, a national recreation area, or a research natural area. Two congressionally designated areas do, however occur within the project area:

- North Sylamore Creek is a congressionally designated Scenic River. It is also a State of Arkansas Extraordinary Resource Water. This 14.5 mile perennial stream, the lands forming the scenic river corridor along both sides of it, and its headwaters occur within the project area. North Sylamore Creek and its corridor occur within Management Area 1.C and as such, are to be managed to enhance and protect the river's three outstandingly remarkable values: recreation, fish and wildlife and botanical) qualities of the river and its surroundings.
- A section of the Sylamore Scenic Byway runs through the project area. The Sylamore Scenic Byway is recognized by congress in the National Scenic Byways Program of the Federal Highway Administration. A designated corridor width of ½ mile on either side of the byway comprises its own Management Area designation in the Forest Plan (1.H).

One-thousand nine hundred twenty- two (1,922) acres of the project area within the Clifty Canyon Special Interest Area are currently managed as a Roadless Area. No tree cutting, removal of timber, mechanically constructed prescribed fire containment line, and no work associated with road maintenance or reconstruction are proposed for that area.

Past, Present and Reasonably Foreseeable Actions within the Project Area

Forest Service Actions

Management actions necessary to protect public safety would be implemented under all of the alternatives examined in this Environmental Assessment. These actions may include one or more of the following: suppression of unplanned ignitions (wildfires), hazard tree removal, routine maintenance of developed recreation areas and administrative sites and routine maintenance of Forest Service and County roads conducted under contract or through formal agreements with county governments.

The projects listed below were analyzed and approved under separate National Environmental Policy Act decisions; they occur entirely or partially within the project area and are in various stages of completion. Activities that have not been completed or that are of a reoccurring nature under these projects would continue to be implemented under Alternative 1. Within the project area boundary, under Alternatives 2 and 3 previously approved activities may continue to be implemented; where previously approved prescribed burning actions overlap with the project area of the Indiana Bat Habitat Restoration Project area, the acres burned would count toward the annual total burned under the latter. Activities approved outside the project area would continue to be implemented.

A spreadsheet listing recently implemented and planned future activities from these projects was generated from the Forests' Forest Activity Tracking System database. Copies of the environmental analyses and decision documents for the aforementioned projects are part of the project planning record.

Projects that are Partially Completed*:*

- *The 2009 Ice Storm Hazardous Fuels Reduction Project*
- *The Rorie Project*
- *The Sugarloaf Project*
- *The Mare Hollow Project*
- *Replacement of the Low-Water Crossings on North Sylamore Creek Accessing the Barkshed Recreation Area and the Upper Loop of the Blanchard Springs Recreation Area and of the Culverted Crossing Over Jack's Branch on the Sylamore Ranger District*

Projects Approving Actions of a Reoccurring Nature:

- *The Utility Corridor Vegetation Management Project*
- *The Kudzu Eradication Project*
- *Middleton Grazing Allotment #17*
- *Landers Grazing Allotment #18*
- *Dorsey Grazing Allotment #19*
- *White River Grazing Allotment #20*
- *Bonanza Grazing Allotment #21*

Projects Completed Within the Last Three Years:

- *The Johnson TSI Project*
- *The Experimental Forest Indiana Bat Habitat Improvement Project*
- *The Green Mountain Project*
- *Compartments 7, 12, 13 and 14*
- *North Sylamore Creek Hiking Trail Re-Route Project*
- *The Dorsey #19(1) Range Allotment Pond Construction Project*

Types of activities approved under these projects include:

- commercial harvests (including salvage and sanitation cuts);
- prescribed burning;
- herbicide treatments for timber stand improvement, non-native invasive plant treatments, range allotment management, wildlife stand improvement, and site preparation;
- reforestation;
- mechanical and manual non-commercial treatments;
- grazing and hay cutting through special use permits;
- road maintenance;
- replacement of low water crossings that impede fish passage;
- culvert replacements;
- road reconstruction;
- wildlife opening construction, reconstruction and maintenance;
- pond construction, reconstruction and maintenance, and
- trail realignment.

Minor special use permits that utilize less than five contiguous acres of National Forest System land but do not result in ground disturbance or alteration of vegetation have also been issued in recent years; similar permits are likely to be requested and issued during the timeframe for this project. They include

- permits to use existing Forest Service roads to access private land;
- permits hold one-time recreation events on existing roads and trails,
- permits to collect firewood in closed timber sale units, and
- permits to mount repeaters to existing communications towers.

<u>Actions on Private Land</u>

No significant negative impacts to resources on the National Forest caused by practices on private land within and adjacent to the project area have been identified to date.

Approximately 14,400 of the 20,092 privately owned acres within the project area boundary are in a forested land use. The District is not aware of plans to convert any of the forested private land to a non-forested land use during the timeframe identified for this project. Because they have been in their current uses for decades, it will be assumed the existing forested land uses will persist over the next 12 years.

No land management activities are being proposed on private land for any of the developed alternatives; however, private landowners may elect to enter into voluntary agreements with the Forest Service or the State to conduct management actions on their properties.

Most of the National Forest System lands within the project area are in a Fire Regime Condition Class 2 or 3 (see Appendix L). Because of this, adjacent private lands eligible to be burned with Community Wildfire Protection Funds through cooperative agreements with the AR Forestry Commission (Stevens agreements); this state agency would be in charge of conducting burns on private land. If accepted into this program, the landowners would receive this service at no cost; therefore, it is likely that this activity could occur. The AR Forestry Commission will be notified when prescribed burns are scheduled on the National Forest.

Any land management actions implemented on private land by the Forest Service through voluntary cooperative agreements would contribute toward the annual implementation limit(s) set for those actions under this project and would be subject to the same design criteria and requirements for implementation.

PHYSICAL ENVIRONMENTS

Soil

The analysis area for direct, indirect, and cumulative effects on soil resources encompasses all land within individual treatment units and landings. Existing classified National Forest system roads and trails are considered dedicated lands for other purposes and, as such, soil quality standards do not apply. The activity area is considered an appropriate geographic unit for assessing direct and indirect soil environmental effects because soil productivity is a site-specific attribute of the land and is not dependent on the productivity of an adjacent area. Similarly, if one acre of land receives soil impacts (i.e. reduced soil porosity, water holding capacity, aeration, long-term productivity etc.) and a second management activity is planned for that same site, then soil cumulative effects are possible. The temporal scales for this analysis can be defined as short and long-term. Short-term effects are those that occur approximately within the first 10 years following proposed management activities. Long-term effects are those that occur approximately after 10 years or more following proposed management activities.

The landscape's morphology is primarily composed of highly dissected uplands with long narrow winding ridges, short steep sideslopes and steep V-shaped valleys that formed in a residuum of cherty limestone. The upland soils are shallow to deep, moderately well to somewhat excessively drained and mostly developed in residuum and colluvium of limestone, very cherty limestone, and inter-bedded sandstone and limestone. The terrace and floodplain soils are deep, well to excessively drained and developed in silty, sandy, cherty, and loamy alluvium.

Soils within the project area are mostly forested and stable. They are covered with pine and hardwood litter, chert gravel, and vegetation except for the soils in stream channels, road beds, and road cut banks. There are a few old gullies from past land use, but they are vegetated and stable. Areas that were impacted by the 2009 ice storm have a more open canopy, but soils are protected by thick mid-story and under-story vegetation. There are some areas of sandy soils that have no chert gravel on the surface, but they are protected by litter, duff, and vegetation (this except in unsurfaced road beds). Information regarding project area soils is provided in Appendix D.

Soil Map Unit Characteristics for the area are summarized in Table 5 below.

Table 5. Soil Map Unit Characteristics Within the Indiana Bat Habitat Restoration Project Area

Hazard	**Slight**		**Moderate**		**Severe**	
	Acres	**% of Area**	**Acres**	**% of Area**	**Acres**	**% of Area**
Hazard of Off Road and Off Trail Erosion	35,962	41	38,653	45	11,961	14
Soil Rutting Hazard	7,725	9	22,954	27	55,897	64
Hazard of Erosion on Roads and Trails	2,627	3	20,085	23	63,865	74
Hazard	**Low**		**Moderate**		**High**	
	Acres	**% of Area**	**Acres**	**% of Area**	**Acres**	**% of Area**
Fire Damage to Soils	40,653	47	31,480	36	14,443	17

Ratings shown for "hazard of off-road or off-trail erosion" are based on slope and on soil erodibility factor K. The soil loss is caused by sheet or rill erosion in off-road or off-trail areas where 50 to 75 percent of the surface has been exposed by logging, grazing, mining, or other kinds of disturbance. The hazard is described as slight, moderate, severe, or very severe. A rating of "slight" indicates that erosion is unlikely under ordinary climatic conditions; "moderate" indicates that some erosion is likely and that erosion-control measures may be needed; "severe" indicates that erosion is very likely and that erosion-control measures, including re-vegetation of bare areas, are advised; and "very severe" indicates that significant erosion is expected, loss of soil productivity and off-site damage are likely, and erosion-control measures are costly and generally impractical.

Ratings for "hazard of erosion on roads and trails" are based on the soil erodibility factor K, slope, and content of rock fragments. The ratings apply to unsurfaced roads and trails. The hazard is described as slight, moderate, or severe. A rating of "slight" indicates that little or no erosion is likely; "moderate" indicates that some erosion is likely, that the roads or trails may require occasional maintenance; and that simple erosion control measures are needed; and "severe" indicates that significant erosion is expected, that the roads or trails require frequent maintenance, and that costly erosion-control measures are needed.

Direct, Indirect and Cumulative Effects

Alternative 1

Because no activities would be implemented, there would be no direct or indirect effects on project area soils from this project if Alternative 1 is selected. Current conditions and trends within the area will continue. Under the *2009 Ice Storm Hazardous Fuels Reduction Project*, approximately 49,000 acres will be treated with prescribed fire, and some fuels will be removed through salvage harvest. Potential severity of wildfire in those areas will be less than in the areas

that will not be treated and so the effects on soils in those areas will also be reduced. No cumulative effects are expected when past, present and future activities are considered because no activities will be implemented. Future entries into the area would likely be several years out. Soils are usually stabilized within 1 to 3 years following completion of an action. By that time, any soil disturbance caused by previously approved actions will have stabilized with vegetation growth and leaf litter cover.

Alternative 2

Forest Plan standards for soils (Forest Plan pages 3-11 and 3-12) are designed so that management activities on forest lands will not significantly impair the long-term productivity of the soil or produce unacceptable levels of sedimentation resulting from soil erosion. The Forest Plan requires the use of State of Arkansas Best Management Practices (available at http://forestry.arkansas.gov/Services/ManageYourForests/Documents/bmpbookrevise.pdf). Generally, detrimental effects on soils are not permanent—lasting generally between 1 to 3 years—and depend primarily on soil texture, parent material, aspect, and level of disturbance. Therefore, significant detrimental impacts to soil resources of the project area are not expected.

Detrimental soil impacts are defined as the proportion of an activity area that may be subjected to displacement, compaction, rutting, erosion, or severe burning due to a particular management activity, exclusive of dedicated resources (such as system roads). The soils in an activity area are considered detrimentally disturbed when the following soil conditions exist as a result of forest practices:

- Soil compaction reduces the supply of air, water, and nutrients to plants.
- Detrimental displacement is the removal of 1 or more inches (in depth) of any surface soil horizon, usually the A horizon, from a continuous area greater than 100 square feet.
- Surface erosion is indicated by rills, gullies, pedestals, and soil deposition and should be kept within tolerable limits by retaining enough ground cover, depending on site characteristics.
- Rutting consists of wheel ruts at least 2 inches deep in wet soils.
- Burns that create very high temperatures at the soils surface when surface soil moisture content is low result in almost complete loss of surface and upper soil horizon organics.

Vegetation management activities can cause soil compaction, displacement, puddling and erosion; most of the impacts are caused when ground cover is removed and soil material is displaced.

Compaction, rutting, displacement, and high intensity burning can affect physical, chemical, and biological properties of soil and indirectly affect a site's capacity to support the growth of plants and plant communities. Compaction reduces soil permeability and infiltration. Road work, use of heavy equipment to conduct timber stand and wildlife stand improvement activities, ground-based yarding, and dozer piling are the major contributors to compaction.

Dragging logs to landings, blading skid trails and landings, temporary road construction, and construction of prescribed fire containment lines can cause displacement which reduces plant growth where topsoil and organic matter are removed.

Erosion occurs when the litter layer is removed and the root mat is cut. Installation and use of temporary roads, skid trails, landings and prescribed fire containment lines as well as road reconstruction, and maintenance actions would initially increase the potential for soil erosion. Loose and exposed soil on road surfaces and within the road prisms would be susceptible to runoff until they become stabilized. To speed the recovery of soil productivity and limit erosion, temporary roads, primary skid trails and log landings will be disked, seeded and blocked following harvesting. Forest Service road design standards, compliance with the Forest Plan, and supervision of harvest activities will ensure erosion is controlled and appropriate drainage features are installed. Prescribed fire containment lines will be bladed and seeded when burning operations are completed. When re-entering a harvested unit to apply follow-up timber stand improvement treatments, signs of erosion, if any, would be detected and erosion control measures would be implemented to mitigate the effect.

Fire can affect soil through transfer of heat into the duff layer and underlying soil. The magnitude of change in soil physical properties depends on the temperature threshold of soil properties and the intensity of the fire (DeBano and Neary 2003). Prescribed fires can potentially result in the same types of impacts on soils as wildfires, but they are generally designed to limit these effects. Direct impacts to soil include charring of the ground surface, a short term reduction (but not complete consumption) in litter and duff, acceleration of erosion from one to three years, and removal of some large woody debris which is essential for maintenance of sufficient microorganism populations and long-term site productivity.

If the litter and duff layers are completely consumed by a high intensity fire, the soil is bare and subject to raindrop splash and erosion. Moderate burns only cause minor erosion because they expose soil on less than 20 percent of the area and recovery usually takes one year. Light burns cause no erosion because they expose almost no soil (Dissmeyer and Stump 1978). Prescribed burns are usually light to moderate in intensity, so resulting levels of erosion are generally negligible. Low-intensity burns have little, if any adverse effect on soil erosion even on relatively steep slopes (Brender and Cooper 1968, Cushwa and others 1971, Goebel and others 1967 cited in Stanturf and others 2002). The remaining duff, root mat, surface gravel and stones protect the soil from erosion.

Wildfires that occur within areas where fuels have been reduced or maintained are expected to burn at a lower intensity than those that occur within areas that have not been previously treated. Because prescribed burns are planned, less fire containment line is needed on steep slopes where potential for erosion is great than that needed to contain a wildfire. When the AR Forestry Commission and adjacent landowners have entered into Stevens Agreements, Forest Service and State burning operations can be implemented simultaneously reducing the need to mechanically construct prescribed fire containment line.

Organic matter helps hold soil particles together and along with biofilms created by soil organisms, aggregates are formed which make up soil structure. Soil organic matter plays a key role in nutrient cycling, cation exchange, and water retention. When organic matter is combusted, the stored nutrients are either volatilized or are changed into highly available forms

that can be readily taken up by microbial organisms and vegetation (Knoepp, DeBano, and Neary 2005). The magnitude of nutrient losses during burning is positively and linearly correlated with fuel consumption (Hough 1981, Raison et al, 1985a; Schoch and Binkley, 1986 cited in Carter and Foster 2003). Low-severity prescribed fire has a minimal effect on soil biota because maximum temperatures are generally nonlethal, except for the upper litter layer, and consumption of forest floor habitat is limited (Busse and DeBano 2005).

Liechty and others (2004) concluded that shortleaf pine-bluestem restoration, which includes harvesting, midstory reductions, and prescribed fire, can alter nutrient availability within surface soils. They found that pH, calcium, total nitrogen, carbon and carbon:nitrogen ratios were increased following approximately 20 years of implementing the restoration activities.

Use of herbicides as proposed is not expected to negatively impact project area soils or soil microogranisms. (USDA FS 2011 a, b and c respectively). Herbicide applications will not cause soil disturbance and roots of treated vegetation will remain in place to protect the soil. For all purposes, the majority of herbicide applications will be selective within treatment units. Glyphosate and triclopyr amine will be used for the majority of timber stand and wildlife stand improvement applications; use of imazapyr will be limited to treatment of some non-native invasive plants. Additional information regarding the effects of the herbicides proposed for use on soils is provided in each of the respective herbicide risk assessments (USDA FS 2011 a, b and c respectively) and the project planning record.

The percentage of detrimentally disturbed acres that would result from implementation of Alternative 2 was estimated using coefficients based on past Forest-wide soil monitoring data. The coefficients were developed by taking the average of the percent of harvested areas that were detrimentally disturbed by various harvest methods. Acres of detrimental disturbance were calculated by multiplying activity area size by the disturbance coefficient derived from monitoring reports. Monitoring information and coefficients used to calculate detrimental disturbance are archived at the Forest Supervisor's Office in Russellville, AR.

Direct effects on soils from proposed activities were estimated by analyzing the effects of compaction, erosion, burning, rutting, and displacement on the soil surface that is the most productive layer and also the easiest to disturb through activities.

If the activities associated with removal of vegetation and prescribed burning of this alternative are implemented at the maximum extents planned, an estimated temporary (generally 1 to 3 years) reduction of soil productivity of 217 acres (or approximately 6 percent per 3,500 acres harvested) would result; this figure includes disturbance caused by skidding , temporary road construction (and subsequent obliteration after use), system road reconstruction, and prescribed fire containment line construction. The expected percent of temporary reduction in soil productivity complies with Forest Plan standard FW85 which requires at least 85 percent of an acitvity area be left in tact for all soils dedicated to growing vegetation. No additional mitigation measures, therefore, would be required.

No effects from past, present and reasonably foreseeable future activities were identified that would combine with the effects of this alternative to result in a detrimental cumulative impact for soil resources. Most of the impacts to the soils will occur where skid trails and temporary roads are located; these installations will be disked, seeded and blocked after use and are typically stablized and productivity restored within 1 to 3 years afterward. Application of Best Management Practices and other Forest Plan standards for soils help to ensure any movement of soil is generally localized within the project area. Future entries into the area would likely be several years out. Soils are usually stabilized within 1 to 3 years following completion of an action. By that time, any soil disturbance caused by previously approved actions and the activities of this alternative will have stabilized with vegetation growth and leaf litter cover.

Alternative 3

Timber stand and wildlife stand improvement work would primarily involve felling stems with chainsaws. The annual extent of mechanical treatments would not be increased. Therefore, the increased acres and number of entries would not cause any additional soil disturbance. Growing season fire would likely be utilized more often than it would in Alternative 2 to remove fire-intolerant under and mid story stems; these burns will be designed to minimize soil exposure. Site conditions will influence the frequency with which growing season fire would be utilized. The extent of herbicide use would be less than that of Alternative 2, so no additional impact would be expected from that activity. The estimated amount of reduction in soil productivity and the cumulative effects of Alternative 3 would be the same as described for Alternative 2.

Water Quality

Drainage basins in the United States are divided and sub-divided into successively smaller hydrologic units which are classified as regions, sub-regions, basins, and sub-basins by the U.S. Geological Survey. The Ozark-St. Francis National Forest further recognizes land area classifications of two progressively smaller units: watersheds and sub-watersheds (6th level). These 6th level watersheds will serve as the analysis area with respect to water resources. The Ozark-St. Francis National Forests utilized its own boundary and name information in the past; these occasionally differ from the current dataset. Where differences in boundaries do occur, the project activities were divided proportionately between the watershed boundaries used in the Water Resources Analysis for Cumulative Effects sediment model (Clingenpeel and Crump 2005). The analysis area used for the water resource effects section of this document is defined by these forest-derived boundaries.

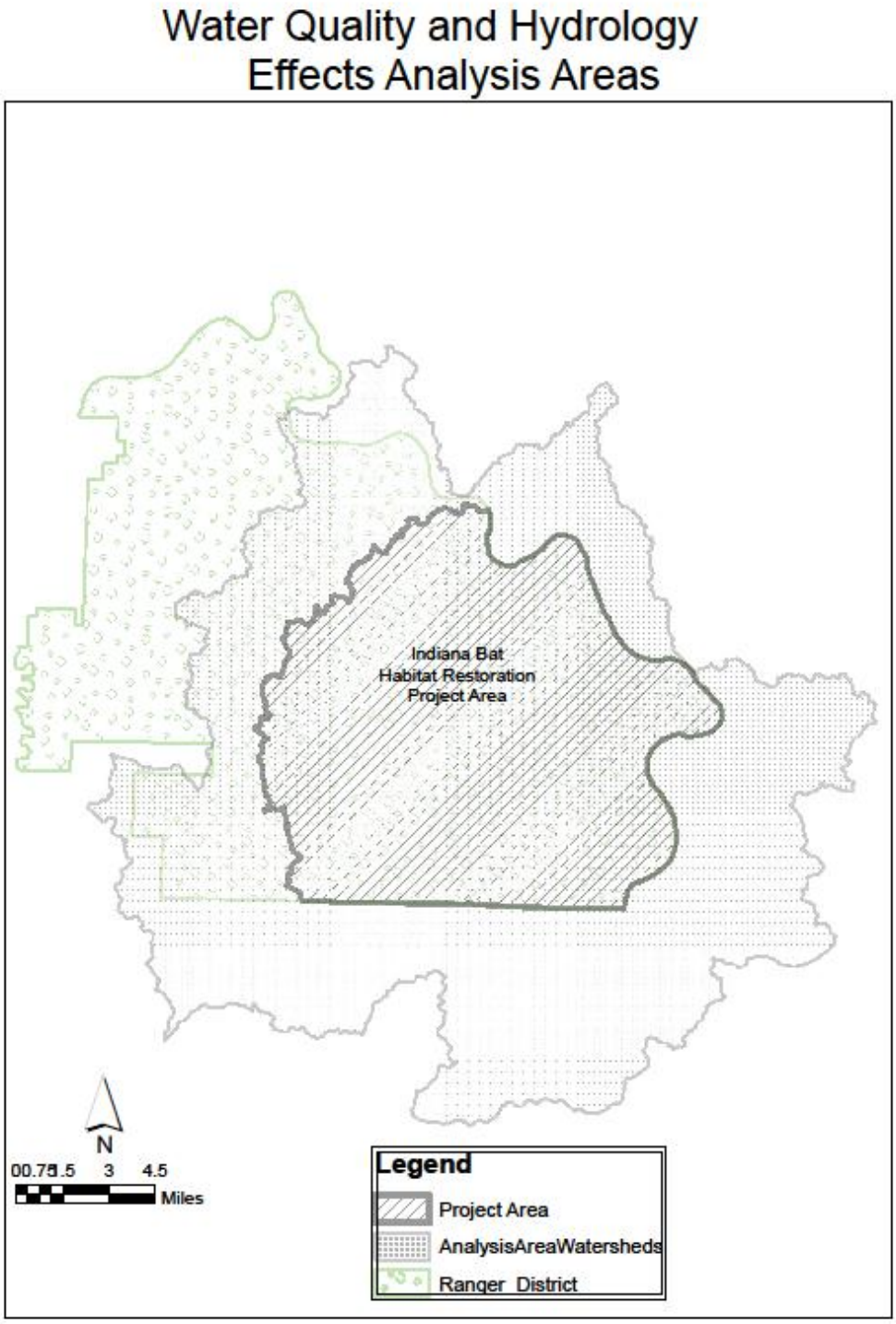
The proposed Indiana Bat Habitat Restoration Project area falls within the Arkansas-White-Red region (11), the Upper White sub-region (1101), the Upper White basin (110100), and the Middle White sub-basin unit (11010004) (United States Geological Survey, 2003). The proposed project falls into three different watershed units: Hicks Creek-White River (1101000402), South Sylamore Creek-North Sylamore Creek (1101000403), and Laferty Creek-White River (1101000404). At the smallest scale, the proposed project is located within ten 6th level watersheds shown in Table 6.

Table 6: 6th Level Watersheds Containing the Indiana Bat Habitat Restoration Project

6th Level Watershed Number	6th Level Watershed Name	Total 6th Level Watershed Acres	Acres of the 6th Level Watershed within the Project Area
110100040205	Sneeds Creek-White River	26,054	5,790
110100040206	Sugarloaf Creek-White River	27,668	15,469
110100040301	Headwaters North Sylamore Creek	29,177	17,577
110100040302	Headwater Roasting Ear Creek	22,529	3,892
110100040303	Outlet Roasting Ear Creek	18,343	1,489
110100040305	Outlet North Sylamore Creek	19,861	19,770
110100040306	Outlet South Sylamore Creek	32,086	4,546
110100040401	Livingston Creek	13,624	13,624
110100040402	Wideman Creek-White River	17,076	3,517
110100040404	East Twin Creek-White River	23,536	1,624
TOTALS		229,954	87,298

Figure 3 below illustrates the relationship between the Ranger District, Analysis Area, and Project area.

Figure 3:


Water Quality and Hydrology
Effects Analysis Areas
Indiana Bat
Habitat Restoration
Project Area
N
00.75 1.5 3 4.5
Miles
Legend
Project Area
AnalysisAreaWatersheds
Ranger District

The analysis area geology consists of Ordovician and Mississippian age clastic sedimentary rocks (McFarland, 2004). The analysis area occurs within the Ozark Plateaus region of Arkansas which is made up of generally flat-lying Paleozoic age strata divided into three plateau surfaces. The Salem Plateau, the Springfield Plateau, and the Boston Mountains. The Springfield Plateau is the landform associated with the analysis area for this project. The primary geologic formation encountered in the analysis area is the Boone formation which consists of gray, fine- to coarse-grained fossiliferous limestone interbedded with chert. Some sections may be predominantly limestone or chert.

Groundwater is found in aquifers and geologic materials capable of storing and transporting water. The principal aquifer unit underlying the analysis area is the Ozark Plateaus Aquifer system. This is a highly productive primary aquifer unit which generally correlates with the Ozark Highlands ecoregion (Renken, 1998). Recharge of the aquifer occurs as precipitation that falls where the aquifer is exposed at the land surface and enters as direct runoff through sinkholes and sinking streams (streams that flow into shallow holes and sinkholes) or by diffuse infiltration through soil cover in the upland and inter-stream areas. The carbonate rocks that compose the aquifer system are readily dissolved by precipitation; the result is partial dissolution and formation of a network of subsurface openings and irregular rock surface called karst topography.

Karst topography is characterized by subsurface pathways of waterflow, gaining and sinking streams, sinkholes, caves, and other openings. Locations for all known karst features are listed and mapped in the project planning record. Karst formation is a continual process, therefore, additional karst features likely exist in the area; these will be mapped and entered into the Forest's geographic information system database as they are found. The locations of hibernacula and other caves on the District are protected under the Federal Cave Resources Protection Act; and will not be disclosed in this document.

The analysis area supports streams and rivers that have physical patterns of both a karst and a dendritic drainage pattern. Dendritic drainage patterns have branching tributaries which concentrate precipitation across a wide area into one main stream channel. There are over 271 miles of streams in the analysis area sub-watersheds as identified using the US Geological Survey National Hydrology Dataset (2000). The primary streams in the project area include Bear Pen Creek, West Dry Creek, Spring Beech Creek, Cole Fork, Stewart Fork, Cataract Creek, Sugarloaf Creek, Sycamore Creek, Bearhead Branch, West Livingston Creek, Islet Branch, Ward Branch, Bad Branch, Livingston Creek, Jacks Creek and North Sylamore Creek. In all but the southwestern portion of the project area, streams converge and flow into the White River. The remainder flow into South Sylamore Creek which also joins the White River at Allison, AR.

There are approximately 135 ponds with a total surface area of near 60 acres in the analysis area. Small dams create Gunner Pool (0.5 acre) and Mirror Lake (2.4 acres) within the Gunner Pool and Blanchard Spring Recreation Areas respectively. Both impoundments hold water year-round. It is not known how many of the smaller ponds hold water year-round.

Drainage of the analysis area is influenced by the road network which essentially increases the landscape's drainage density by mimicking the stream channel network. Roads intercept rainfall, concentrate flow, and divert water from traditional pathways. Road density within the analysis area watersheds is 5.25 miles per square mile. Within the project area boundary, the road density is 3.6 miles per square mile. These figures do not include user-created (illegal) Off Highway Vehicle trails known to exist on the District, most of which have not been mapped.

Forested land uses indicate a stable landscape that results in minimal amounts of natural or background erosion, especially for Arkansas. (Miller and Liechty 2001) For many parts of the Ozark-St. Francis National Forests, the prevalent soil cover contains many rocks and rock fragments which ultimately limit the erosive susceptibility of the soils. Measured erosion for minimally disturbed forest lands rarely exceed 0.25 tons per acre where soil erosion from cropland has been estimated at 3.8 tons per acre (Patric et al. 1984; USDA SCS 1989). Across all ownerships in the 6th level watersheds of the analysis area, approximately 88 percent is in a forested land use with the remainder primarily in agriculture. In the project area boundary, approximately 98 percent of National Forest Service lands are forested.

Mass wasting is a phenomenon that occurs within the Ozark Highlands. There is always some probability for the occurrence of mass wasting present; the likelihood for this to happen is increased by changes in land use and extreme climatic events. Substantial rainfall over short periods of time can initiate instability of soil cover and surrounding substrate creating landslides. These effects are exacerbated where changes in land use have occurred. No instances of mass wasting are presently known within the project area.

Water quality is determined by physical, chemical, and biological characteristics. The proposed project is located in the Ozark Highlands Ecoregion as identified by the EPA (2003) as a revision of work produced by Omernick (1987). These are the same Ecoregion divisions recognized by the State of Arkansas for use in defining water quality standards. Water quality standards for the project area, and the sub-watershed analysis area for this project, are determined by the Arkansas Pollution Control and Ecology Commission Regulation 2 – Water Quality Standards for Surface Water (Regulation 2, 2004). Regulation 2 is available at http://www.adeq.state.ar.us/regs/default.htm. The designated uses assigned to the surface waters in the project area are presently being met.

Atmospheric deposition is not currently a significant issue in the Ozark Mountain region of Arkansas. Concentrations of nutrients in Ozark Mountain stream systems are typically very low because they are assimilated rapidly by plants and bacteria. Nutrient levels for some stream systems in the Ozarks, however, are dominated by the runoff from animal waste spreading operations and typically occur where there is a large concentration of confined animal operations such as chicken houses. The waste water treatment facility servicing the Blanchard Recreation Area is permitted as a National Pollutant Discharge Elimination System discharge site. This facility discharges to North Sylamore Creek.

Section 303(d) of the Clean Water Act requires that states identify waters which do not meet or are not expected to meet applicable water quality standards. These water bodies are compiled into a list known as the 303(d) list. There are no 303d listed waters within the analysis area.

Many of the area streams flow into North Sylamore Creek, a congressionally designated Scenic River and a State of Arkansas Extraordinary Resource Waterbody. This perennial stream flows southeast through the project area to the White River. There are no AR Department of Environmental Quality water quality monitoring locations within the analysis area, but the US Geological Survey operates a stream gauging site on North Sylamore Creek near the Gunner Pool recreation area. This is one of the US Geological Survey's National Hydrologic Benchmark Stations and has actively recorded gauge height for more than 40 years.

A source water assessment produced by the AR Department of Health provides information regarding wells and intake structures on reservoirs and streams for municipal supplies. Five water supply intakes are located within the project area; eleven more are located outside the project area but within the cumulative effects analysis area. Of these, only one is a surface water intake. The others are public and privately owned groundwater wells. The five intakes within the project area are all located on the southwestern half. The entire project area occurs within the water supply protection area delineated for the Mountain View Water Works. The locations of these intakes will not be disclosed in this Environmental Assessment as a matter of security.

An extensive time period record (>100 years) for water flows from this area is lacking. The typical runoff from large watersheds in the region averages 15 inches per year; roughly one-third of the precipitation becomes stream flow.

Wetlands are designated under the Federal Clean Water Act and generally include swamps, marshes, bogs and similar areas. No wetlands were identified within the project area. This determination was made by comparing the project area to numerous data sources describing wetland locations including the National Wetland Inventory database, the State Soil Geographic Database, and detailed forest level soil survey information.

Floodplains generally contain unconsolidated sediments such as sand, gravel and silt that extend below the bed of the stream or river and act as areas of groundwater recharge. They can support particularly rich ecosystems, both in quantity and diversity where markedly different species than those found outside of floodplains grow. Additional floodplain functions include sediment storage, floodwater storage, peak flow moderation, channel stability, and erosion prevention. Using a detailed forest level soil survey, approximately 2,444 acres of floodplains were identified within the project area; they are primarily located in the lower reaches of perennial streams.

Direct and Indirect Effects

Alternative 1
Direct effects will not result from management activities of this project because none will be conducted. The effects of vegetation on water yield within the 6th level analysis area watersheds will continue through interception and evapotranspiration processes.

Alternative 2
When conducted as proposed for this project, the activities of Alternative 2 are not expected to degrade water quality or result in long-term impacts to water resources, because the potential degree of effect to water quality will be mitigated through compliance with Forest Plan standards and by utilizing practices that minimize non-point source pollution contributions from harvest, burning, herbicide use and road management actions.

Potential effects from forest management activities depend greatly on site conditions, methods utilized, climate, and other environmental factors. The major types of potential pollutants produced by forest management activities include sediment, notable changes to nutrient cycling from harvested or burned areas, and runoff containing forest pesticides.

Most impacts from typical management activities are usually transient and rarely severe enough to threaten fish populations; the use of Best Management Practices is generally effective in the prevention and mitigation of potential impacts (Brinkley and MacDonald 1994).

Best Management Practices are designed to increase the likelihood that when erosion and sediment production occurs is effectively retained on upland and floodplain areas instead of being transferred to stream channels and aquatic systems; they are implemented as standard operation procedures for all activities conducted on the Forests including those conducted under contract. Stream channels and karst features are protected through streamside management zones and karst management zones; actions that disrupt the forest floor within these zones are restricted enabling them to retain their filtering and sediment trapping functions. Minimum widths for streamside and karst management zones are outlined in Forest Plan standards FW78, 81 and 87 and FW43, 44, 45 and 46 respectively.

Whether sediment reaches a stream, or is deposited further downslope depends on site conditions such as distance to stream, slope, and presence or absence of intact forest floor materials. Soil erosion that actually reaches a stream channel has been found in many cases to be a small fraction of the total mobilized (Hewlett, 1982). Some sediment is always present in streams, but if it reaches a stream in unnaturally high levels, it can have an adverse impact on aquatic habitat.

Because soils will be disturbed, road work to facilitate removal of timber (purchaser road maintenance, temporary road construction, road reconstruction), installation of skid trails and log landings and construction or re-opening of prescribed fire containment lines will cause an increase in sediment production over current levels. These increases, however, will be temporary—lasting between 1 to 3 years after the work is completed. As the system roads stabilize, the level of sediment generated from them will decrease to previous levels or less.

When a harvest operation is completed, temporary roads, skid trails and log landings will be disked, seeded and blocked and prescribed fire containment lines will be bladed and seeded to hasten stabilization. These installations are typically re-vegetated within a 1 to 3 year timeframe.

The effects of prescribed fire on water quality are a function of ground cover removal (Marion, 2004). The amount of sediment generated after a prescribed burn depends on soil erodibility, slope, precipitation timing, volume, intensity, fire intensity, and soil cover remaining. Erosion has been found to remain within the treated site with low intensity fire that avoids complete consumption of the organic layers (Fulton and West, 2002). Eighty-five percent or more of the organic layer and root mat are expected to remain intact more after prescribed burns conducted for this project (see the 'Soils' analysis); therefore, conditions for levels of soil erosion that would impact water quality should not result. For projects designed to meet wildlife, recreation, watershed, vegetation management, or ecological objectives there is little evidence that sedimentation or water yield increases significantly in streams from forestlands burned under conditions specified in a prescribed burning plan.

Changes in land use are not proposed for this project, and are therefore not expected to contribute to conditions that would cause landslides or mass wasting events. However, there is always potential for landslides and mass wasting to occur if extreme climatic events occur as these events cannot be modified.

Generally stream water concentrations of nitrate and other nutrients are very low and rarely have been found to exceed the level identified for drinking water standards (Brinkley and Brown, 1993). The sudden removal of vegetation through timber harvesting or widespread loss due to a disturbance event can increase nutrient transport to streams by increasing leaching and erosion processes. Nutrient levels in streams can also increase as a result of fertilizer applications. The effectiveness of best management practices for controlling nutrient export was demonstrated in a long term study by Lynch and Corbett (1990). They examined implications of nutrient loading after timber harvest for streams in the south, and found that water quality standards are not exceeded and nutrient concentrations only show a marked increase during the treatment year when Best Management Practices similar to those required for use with this project are utilized. These include:

- 100 foot wide perennial stream buffers;
- removal of logging slash from streams;
- monitoring of sale units by a responsible party;
- ceasing operations during wet weather;
- using culverts to cross perennial streams during harvest and removing them when the operation was done;
- utilization of water bars;
- maintenance of filtration strips.

After the first few years following treatment, nutrient concentrations rapidly decline to pre-event levels. Increases in nutrients will present themselves mainly as increased nutrient loading to small reservoirs and lakes downstream from the site occurrences if they are present. The impacts from any potential nutrient increases are expected to be negligible as dilution from runoff across the watershed feeds the primary analysis area streams.

Prescribed and wildfire can impact water quality by heating the soil and killing soil organisms, thereby altering nutrient transformation rates and bioavailability. These impacts depend on the fire's severity. Fire will create ash which can be eroded or dissolved and deposited or transported to aquatic systems. Suspended solids and dissolved salts or metals could be contributed to stream flow via surface runoff if an infrequent large precipitation event immediately followed a controlled burn. Prescribed fire alone is not expected to increase nutrient content within downstream receiving water bodies (Marion, 2004). A study by Van Lear and others (1985) found that erosion and sedimentation following prescribed fire activity was mainly due to plowed fire lines as opposed to erosion from the general treatment area. Minor increases in stormflow and nutrients were present, and these effects returned to pre-treatment levels within 3 years of the activities. Other studies from the southeast focused in mountain and piedmont type landscapes revealed that stream NO_3-N and NH_4-N concentrations were unaffected by prescribed fire of any intensity; and slight increases in stream NO_3-N concentrations were observed under wildfire scenario modeling exercises, but responses were below levels of concern for aquatic resources and drinking water (Vose et al. 2005).

Adverse impacts of increased water flows are significant in two particular regions, those where rain-on-snow events result in mass wasting and in coastal pocosin wetlands, neither of which occur in this region of Arkansas. Increases in runoff from forested watersheds as a result of harvesting are well documented for many forest types (Patric 1980), usually surfacing as increased peak flows during seasons of typical runoff periods. Water yield is found to increase for two reasons, 1) more precipitation reaches the ground, less interception, and 2) vegetation removal ceases evapotranspiration processes. The magnitude of these changes is directly related to the amount of forest cover removed and the site conditions such as climate, soil type and stream ecosystems. Increases in runoff and flow are temporary, lasting until the treatment has ended and vegetation cover is restored on the site (Patric, 1980 and Swindel et al., 1983). This conclusion is supported by research by others including Stettergen and Krstansky (1987), Scoles et al (1996), and Stednick (1996):

- Studies in the Missouri Ozarks by Settergren and Krstansky (1987) indicate that for small watersheds where a regeneration treatment has occurred slightly higher storm flows and peak discharges have been noticed, however, the absolute amounts of increased yield are minor. This study also noted that the time to peak and total flow duration were unchanged.
- Research conducted in Oklahoma and Arkansas reported that stormflows increased an average of 4 inches/surface area from both clearcut and selectively cut watersheds in the year after timber harvest compared to uncut watersheds. This measured increase is not significant due to the variability associated with storm flows between watersheds. Thus increases are present but they are not statistically significant (Scoles et al., 1996). Another study by the same authors concluded that increases in stormflows off clearcut watersheds were greater than those off control watersheds during low-flow periods, primarily the growing season and fall. These effects are expected to occur for the first few years in local areas where a majority of the canopy is removed during regeneration type harvests.

- Using paired watershed studies for regions of the United States, effects of silviculture practices on annual average stream discharge were depicted by Stednick (1996). In this study, the actions necessary for producing measurable increases in water yield from forests in Arkansas was determined to be a fifty percent reduction in basal area across an entire watershed. This level of vegetation harvest would result in an increase of roughly six inches above normal runoff values for the first year. The recovery period for water yield to return to pretreatment level was found to be a function of vegetation re-growth. For Arkansas, this means that water yields should return to pretreatment level quite rapidly; however changes to peak flow and storm flow timing may continue if drainage patterns are altered by activities such as road construction.

Removal of vegetation for this project will not be sudden or at levels that would cause a significant increase in runoff over existing conditions. Reductions in basal area for most treatment areas will be incremental over a period of years, and this project proposes no permanent additions to the existing road network to increase road density. Size of regeneration units will be limited to 80 acres for pine and 40 acres for hardwood except where fire, storm, insect or disease attack have created regenerating conditions (Forest Plan standard FW02). Regeneration areas will be distributed so that no more than 30 percent of 1,000 acres is in the 0-20 year age class (Forest Plan standard FW04) and no more than 10 percent of the entire project area will be in the 0-10 year age class at any time (Forest Plan standard FW68). Mechanical treatments with machinery could result in small patches of erodible soil.

With any action that involves the use of herbicide, potential exists for herbicide residues to enter waterbodies, therefore, selection of this alternative could potentially result in low levels of herbicide residues entering waterbodies within the project area but are not anticipated to be in excess of levels of concern established by the US Environmental Protection Agency; this determination was made from a review of literature surrounding herbicide application and its use on forest lands, and Forest wide monitoring results.

Pesticides are common chemicals used in a variety of applications and have been found in surface water, ground water, and in wells. Often these residue concentrations are far below levels harmful to human health and the occurrence is infrequent. Reports of pesticide contamination of water are usually from agricultural uses or urban applications (Kolpin et al., 2000; Michael et al., 2000). Forest management options typically include the use of chemical pesticides in the form of herbicides to control competing or inappropriate (non-native invasive plants or other nonnative plantations) vegetation growth. The use of chemicals may affect stream habitats directly through acute or chronic toxic effects or indirectly as a result of changes to the composition of plant communities.

Direct effects depend on two factors: (1) the toxicity of the herbicide and (2) the level of exposure. Toxicity varies among the products used, where common chemicals such as glyphosate (without added surfactant) are only slightly to non-toxic to aquatic organisms to chemicals such as triclopyr ester (which will primarily be used to treat non-native invasive plant infestations and will not be used within streamside management zones) pose a greater potential for fish and invertebrate toxicity. Exposure is determined by such things as application rate,

chemical behavior in the environment and biological factors. Many chemicals used in forestry applications—including those proposed for use with this alternative—break down fairly rapidly under normal conditions, usually within several weeks (USDA FS 2011a, b and c respectively;; Tu et al 2001 revised 2003)

Chemicals can enter surface waterbodies by direct application, wind drift, mobilization of residues in water, overland flow, leaching, and accidental spills transporting herbicide to a work site. Direct application, drift, and mobilization during intense precipitation are the most likely sources of exposure. When herbicide fate is measured in runoff water, two common outcomes are apparent: (1) measured peak concentrations are of short duration, and (2) the highest concentrations occur when buffer strips are not used on streams or where the streams were accidentally over flown during aerial application. However, where buffer strips are used or other mitigation techniques are employed, forestry herbicides generally do not pose a threat to water quality (Neary and Michael 1996). Herbicide will not be applied by airplane with this project. Buffer strips between treated vegetation and streams (FW81), between treated vegetation and karst features (FW43) and between treated vegetation and private land (FW26) will be employed as directed by the Forest Plan.

Michael and others (2000) found that although short term, low-level stream contamination has been observed for ephemeral to first order streams draining some studied sites, levels of herbicides in these streams have been neither of sufficient concentration nor of sufficient residence time to cause observable impacts on aquatic ecosystems.

Glyphosate is frequently used in forest ecosystems because of its low mobility. Most studies have measured peak glyphosate concentrations in stream flow at or below 10 mg/m^3 (an order of magnitude below the US Environmental Protection Agency established health advisory level). Triclopyr is also a common herbicide used in forestry applications. In their review of studies looking at stream flow fate of these and other chemicals, Neary and Michael (1996) found when buffer strips are employed as a mitigation measure, peak concentrations of these chemicals have not been found to exceed 40 mg/m^3 which is below the reference dose of triclopyr. In forest dissipation studies, reported values for the half-life of imazapyr range from 14 to 44 days in forest litter, 9 to 34 days in forest soils, and 12 to 40 days on plants. In a review of literature concerning use of imazapyr Michael and Neary (1993) reported that of 23 studies analyzed, maximum concentrations in streams never exceeded health advisory limits.

The Ozark-St. Francis National Forests monitors water in streams running through herbicide treatment units under its Water Quality Monitoring Plan (2007); this plan is provided in Appendix E of this Environmental Assessment and it will be followed for this project. Herbicide samples will be collected in duplicate above and below a sampled unit and analyzed by a certified laboratory. The lowest levels that a laboratory can detect are well below levels of concern; since sampling and testing began under this monitoring plan, the overwhelming majority of samples tested have been below laboratory detection levels, and while herbicide residue has been detected in a few samples over the past few years, none approached the lower level of concern (personal communication with R. Monk, Ozark-St. Francis National Forests' Hydrologist).

Forestry use of herbicides poses a low pollution risk to groundwater because of its use pattern. Herbicide use in forestry is only one tenth of one percent of agricultural usage and likely to occur only once or twice over rotations of several decades. The greatest potential hazard to groundwater comes from stored concentrates, not operational application of diluted mixtures (Neary and Michael 1996). Regional, confined, groundwater aquifers are not likely to be affected by silviculture herbicides (Neary 1985).

Surface unconfined aquifers in the immediate vicinity of herbicide application zones have the potential for contamination as they are directly exposed to root zones and therefore, potentially to herbicide exudates. Caves, sinkholes, and other karst landforms are known to exist in this project area; these features may connect directly with underground voids. The locations for some of these features are known, but because karst formation is a continual process, it is expected that others will be found during field examinations; their locations will be documented as they are discovered. Observance of karst management zone restrictions and oversight by trained Forest Service personnel will help to protect any karst features that are known to exist in the project area or that may later be discovered.

Proper handling precautions during herbicide transport, storage, mixing-loading, and clean-up are extremely important for preventing groundwater contamination (Neary and Michael, 1996). The only known groundwater contamination of bedrock aquifers, persisting greater than 6 months in concentrations in excess of the water quality standards in the southeastern United States involved extremely high rates of application, or spills of concentrates. In these instances, herbicide residue was detected in groundwater 4 to 5 years after the contamination. These situations are definitely not typical of operational use of forestry herbicides. Forest Plan standards require proper handling precautions be taken and that application crews be supervised to ensure compliance with those requirements. Practices such as taking only the amount of herbicide needed for a day's work to the site will also reduce the potential for this occurrence.

Degradation of surface and ground waters from herbicide use as proposed are not anticipated because

- All aspects of herbicide use will be supervised by trained Forest Service personnel who are also certified pesticide applicators.
- Herbicides will not be applied directly to soil or waterbodies or within karst management zones.
- Herbicide use within streamside management zones will be limited to treatment of non-native invasive plant infestations; only formulations of glyphosate or triclopyr amine labeled for aquatic use (without surfactant) would be used.
- The majority of treatments will be selective with either glyphosate or triclopyr amine herbicides, and the application rates will be at or below labeled rates.
- The mobility potential for glyphosate and triclopyr herbicides are low and intermediate respectively.
- Imazapyr is mobile in runoff and surface water and has potential to exude from roots of treated plants into the soil and groundwater. However:

    - The use of imazapyr will be limited. It is only proposed for the treatment of some non-native invasive plants.
    - The amount of imazaypr that would be applied per acre is not a quantity that is likely to move through buffer zones or to leech a significant distance through soil.
- Forest Plan standard FW23 requires that weather be monitored when herbicide applications are scheduled to limit the likelihood herbicides could be washed from treated vegetation onto soil and off site by rain.
- Large drop size and low pressure will be used to reduce the potential for drift.
- Not all herbicide applications proposed will be made simultaneously.
- Monitoring will help to ensure environmental quality is maintained.

The indirect effects of removing vegetation with herbicide on water quality are similar to the indirect effects of mechanical vegetation removal. Michael et al (2000) found that herbicides used properly can help protect water quality through the reduction of sediment introduced to streams while accomplishing forest management goals. Maxwell and Neary (1991) concluded in a review that the impact of vegetation management techniques on erosion and sedimentation of water resources occurs in this order: herbicides < fire < mechanical. They also concluded that sediment losses during inter-rotation vegetation management could be sharply reduced by using herbicides and moderate burning instead of mechanical methods and high intensity burning because more organic matter is left in place reducing the potential for off-site soil movement following harvest activities. 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 responsibly (Neary and Michael 1996). The use of herbicides to control non-native invasive species, therefore, would be expected to have fewer disturbance-based impacts than achieving the same results using mechanical treatments or grubbing.

Immediately during and after any activities in a floodplain, floodplain functioning may be temporarily affected, but disturbances will not likely disrupt proper functioning when activities are implemented as designed. All actions proposed have potential to occur in riparian corridors—which are wider than streamside management zones; management area standards for riparian corridors, observing restrictions within streamside management zones and practices such as shutting down an operation when soils are wet and rutting is likely to occur will ensure effects in these areas are limited. Besides providing improved foraging habitat and increasing the likelihood roost trees will be provided in the future, the activities included in this alternative will ultimately improve the health and vigor of the Forest, reduce the potential for widespread loss from insect and disease attack and control the spread of non-native invasive plants; floodplain functioning therefore, should therefore improve over time.

Because they do not occur in the project area, the activities described in this alternative will not affect wetlands.

Aforementioned risks to water quality (sediment, nutrients, herbicide contamination) also extend to underground karst environments which are traditionally considered more delicate (less robust)

than normal surface water aquatic environments. Observance of restrictions within karst management zones will reduce the potential for contamination of these environments.

Alternative 3

This alternative will result in an increase in acres treated with chainsaws and a more frequent fire return interval for some areas. Multiple entries will be required to achieve similar results as a single application of herbicide. The total number acres that could be treated annually with mechanical equipment or prescribed burning are the same as Alternative 2.

The increased number of acres treated with handtools and additional entries should not result in additional soil disturbance. The number of acres burned each year will not be increased, but return intervals in some areas may be shorter and seasonality of burning operations may be different than Alternative 2 to remove under and mid story vegetation competing with regeneration of overstory species. These differences are not likely to result in a significant increase of sediment production. Use of buffer zones will help decrease possible sediment inputs to streams, waterbodies and karst environments.

Because the extent of herbicide use would be far less than that of Alternative 2, the potential for contamination of surface and ground water would be less as well.

Cumulative Effects

Alternative 1

When considered with other past, present and reasonably foreseeable actions, no cumulative effects to water quality from management practices will occur because no new actions will be implemented if Alternative 1 is selected.

Other projects being conducted within the analysis area will continue as planned; these projects have been assessed with respect to past, present, and future conditions and implementation of those projects also involves the required use of Best Management Practices and compliance with Forest Plan standards for water quality. None of the previously approved projects involve changes in land use, and are therefore not expected to contribute to conditions that would cause landslides or mass wasting events. However, there is always potential for landslides and mass wasting to occur if extreme climatic events occur as these events cannot be modified.

Alternatives 2 and 3

Cumulative effects result from land uses and land use practices which occur throughout the watershed, on both private and public lands. The primary non-point source pollution concern that arises from Forest Service activities is soil erosion which can result in increased sedimentation of aquatic habitats or threaten water quality as turbidity. Sediment contributions are the source of the most pervasive risks to water quality across the analysis area. Therefore modeling increases in sediment contributions that may result from the past, existing and future conditions combined with the proposed activities are useful for determining potential impacts to water quality. For this analysis, the cumulative effects to water resources will be bound by the 6th level watersheds in which the project is located.

It is not expected that project activities of Alternatives 2 or 3 or previously approved management activities within the watershed will contribute to significant negative cumulative impacts from sedimentation within the analysis area or beyond it. The analysis and project areas are predominately in forested use. On most of the private land within the project area and surrounding the District this has been the case for decades; therefore, it is reasonable to assume that these lands will remain in forested use during the next 10 to 12 years. If plans to convert private lands from a forested use to a non-forested use are identified, they will be considered when annual programs of work are being developed. Programs of work will be adjusted accordingly.

The Water Resource Analysis for Cumulative Effects model (Clingenpeel and Crump 2005) was used to estimate sediment yield from existing land uses, the existing road network and from expected current and future activities. Activities and land uses identified for areas not administered by the Forest Service were determined from publicly available data. For this model, current and future sediment yield is compared to estimates of an undisturbed landscape (or past condition). Future sediment yield increases are determined based on the proposed activity of this project and known activities that are to take place in the analysis area. An undisturbed landscape is described as an entirely forested watershed without roads. The results are determined as a percent increase above the undisturbed amount. The percent increase is then compared to predetermined risk indicator values for the ecoregion where the activities occur.

The assumption is made that all the activities on public lands as described under each alternative, will occur during a one year time frame, or as an instantaneous event. In practice these activities are usually spread over a number of years, thus amortizing the potential effects over the life of any resulting projects. Assumptions are included in the determination of the risk indicator values; these values were determined on a smaller-scale, ecoregion basis, using community based fish information.

The cumulative effects analysis was completed based on the activities described in this document, those of previously approved management activities implemented in the past 3 years and those planned for implementation within the next 3 years. The results indicate that each of the 6th level watersheds within the analysis area is currently found to have a low concern level. Under Alternatives 1, 2, and 3 the concern level will remain low. Supporting materials and complete modeling outputs are included in the project planning record.

A low concern indicates a minimal risk to water quality, or no expected adverse effects to water resources or the designated uses with the implementation of Forest Plan standards and Arkansas Best Management Practices for silviculture. Proper application of all Forest Plan standards and Arkansas Best Management Practices will be verified through implementation monitoring.

The activities proposed by the Forest Service for the action alternatives will not result in significant increases in sediment when implemented as proposed. Though they will generate additional sediment from the landscape, from a watershed perspective, they will contribute only a small (if any) increase to the overall estimated sediment yield. The no action alternative results in an estimated sediment contribution in the watershed because of the ongoing private land uses

and from other projects already being completed. The action alternatives result in a slight overall increase in estimated sediment production for the analysis area, but not a change in the overall risk to water resources. Additionally these activities will be scheduled over a period of years instead of instantaneously as predicted by the analysis, thus reducing acute effects.

Observance of streamside and karst management zones, buffers between water intakes and private land, and other applicable Forest Plan standards will also help to ensure that the proposed management activities do not pose a substantial risk to water quality and that the standards determined by the state for the identified designated uses are not exceeded. Monitoring and Best Management Practices compliance checks should be adequate to discern any adverse effects that may have resulted from the implementation of either adaptive management alternatives.

Fertilizers are not proposed for use with either of the developed alternatives, but nothing precludes the potential for application of animal waste within the watersheds by private landowners. Nutrient additions of this type could greatly exceed any changes brought about by increased leaching of forest soils.

It is not expected that herbicide uses as described for Alternatives 2 or 3 or previously approved management activities within the watershed will contribute to significant negative cumulative impacts within the analysis area or beyond it. Herbicide applications proposed for this project will not occur at once, nor are the applications planned across one contiguous area. Because of the low rates applied and the timing between applications, any herbicide residue remaining in treated stems or exuded by plant roots will have degraded before a subsequent application in a treated area is likely to be made; therefore, herbicide accumulation in the environment is highly unlikely.

Future management activities on National Forest lands within or adjacent to the project area may include the use of herbicide to control vegetation. Herbicide use on other ownerships within the project and analysis area 6th level watersheds will also likely occur. Law requires herbicide users read and follow label specifications; therefore, it is reasonable to assume that all herbicide users will follow label directions for application rates and usage. An herbicide label is its primary communication to users; it reflects the numerous scientific studies and regulatory reviews generated by the Environmental Protection Agency's registration process which provides assurance that

- potential benefits of use outweigh any potential risks and
- when used according to label directions, will not cause unreasonable adverse effects on humans, fish and wildlife or the environment.

Herbicide application by the Forest Service and other entities within label restrictions, therefore, is not anticipated to have any cumulative impact on water resources.

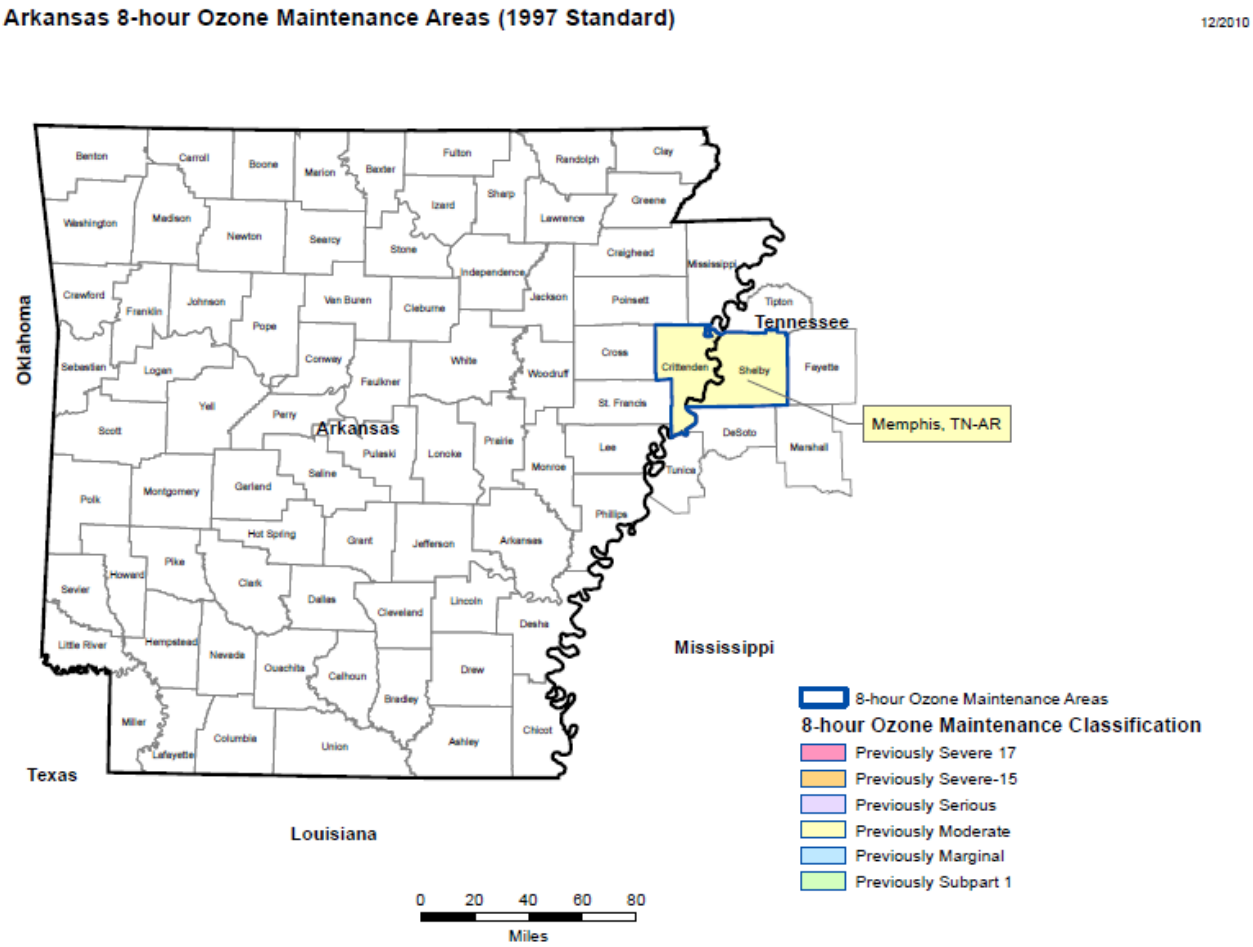
Air Quality

The framework for controlling air pollutants in the United States is mandated by the 1970 Clean Air Act, as amended in 1977 and 1990 (*42 U.S.C. §7401 et seq.).* The Clean Air Act was designed to "protect and enhance" the quality of the nation's air resources; it encourages reasonable Federal, State and local government actions for pollution prevention. State Implementation Plans are developed by each state to implement the provisions of the Clean Air Act. The State Implementation Plans describe the State's actions to achieve and maintain the National Ambient Air Quality Standards.

The US Environmental Protection Agency developed the National Ambient Air Quality Standards for a specific set of "criteria" pollutants designed to protect public health. States can adopt standards even more stringent than the federal standards. National Ambient Air Quality Standards are defined as the amount of a criteria pollutant above which detrimental effects to public health (or welfare) may result. National Ambient Air Quality Standards are set at a conservative level with the intent of protecting even the most sensitive members of the public including children, asthmatics, and people with cardiovascular disease. Additional information for each of the criteria pollutants is provided in Appendix F of this Environmental Assessment.

If an area consistently violates one of the National Ambient Air Quality Standards, that area becomes federally designated as a "non-attainment" area. States must demonstrate to the public and the US Environmental Protection Agency how a non-attainment area will meet the National Ambient Air Quality Standards, based upon the control of emission sources. Such demonstrations employ control plans that are part of each State Implementation Plan including emissions from prescribed fire. In Arkansas, there are no non-attainment areas; only one county in Arkansas is in Maintenance (Crittenden County). Its location is shown below in Figure 4. (Source:epa.gov/oaqps001/greenbk/ancl.html)

Figure 4.


Arkansas 8-hour Ozone Maintenance Areas (1997 Standard)
12/2010
Oklahoma
Tennessee
Memphis, TN-AR
Arkansas
Mississippi
Texas
Louisiana
Benton
Carroll
Boone
Marion
Baxter
Fulton
Randolph
Clay
Washington
Madison
Newton
Searcy
Izard
Sharp
Lawrence
Greene
Stone
Independence
Craighead
Mississippi
Crawford
Franklin
Johnson
Pope
Van Buren
Cleburne
Jackson
Poinsett
Tipton
Sebastian
Logan
Conway
Faulkner
White
Woodruff
Cross
Crittenden
Shelby
Fayette
Yell
Perry
St. Francis
Scott
Pulaski
Lonoke
Prairie
Monroe
Lee
DeSoto
Marshall
Tunica
Polk
Montgomery
Garland
Saline
Phillips
Hot Spring
Grant
Jefferson
Arkansas
Howard
Pike
Clark
Sevier
Dallas
Cleveland
Lincoln
Desha
Little River
Hempstead
Nevada
Ouachita
Calhoun
Bradley
Drew
Miller
Columbia
Union
Ashley
Chicot
Lafayette
8-hour Ozone Maintenance Areas
8-hour Ozone Maintenance Classification
Previously Severe 17
Previously Severe-15
Previously Serious
Previously Moderate
Previously Marginal
Previously Subpart 1
0
20
40
60
80
Miles

The entire District lies within lands designated as a Class II area defined by criteria given in the Clean Air Act. This designation means that the geographic area is designated for a moderate degree of protection from future degradation of air quality and that all six criteria pollutants meet National Ambient Air Quality Standards.

Class I areas provide for the most stringent protection of air quality and air quality related values (such as visibility). The closest Class I airshed to the assessment area is the Upper Buffalo Wilderness located approximately 56 air miles west southwest of the Sylamore District. Ambient air quality and visibility monitoring for Class I areas are typically done collaboratively with the states. Impacts to regional and sub-regional air are addressed operationally through a coordinated smoke management program. The US Environmental Protection Agency urges states to develop, implement and certify smoke management programs that meet the recommended requirements of the Interim Policy. If a "certified" program is in place and smoke exceeds the particulate standard, it may not be considered a violation by US Environmental Protection Agency (Dzomba 2005). Arkansas has an approved smoke management program.

The Arkansas Forestry Commission's Smoke Management Program contains guidelines for prescribed fire which are designed to limit public safety hazards posed by smoke intrusion into populated areas; prevent deterioration of air quality; prevent National Ambient Air Quality Standards violations; and limit visibility impairment at Class I areas or other smoke sensitive areas. These guidelines address when to burn, not how to burn. Actions to minimize smoke impacts are also provided in the Smoke Management Program. This document is available on the internet at
http://forestry.arkansas.gov/Services/KidsTeachersEveryone/Documents/ArkansasVSMG.pdf
and has been incorporated by reference.

Local visibility is affected by several variables including the amount, size, and type of air borne particulates. Visibility data from the Class I Areas at Caney Creek Wilderness, near Mena, Arkansas, and Upper Buffalo Wilderness near Deer, Arkansas air quality monitoring stations have remained relatively constant for the past seven years. The average annual visual range is approximately 56 km for Caney Creek and 55km for Upper Buffalo. Between 2004 and 2010 the visual range has been as good as 169 km and as low as 20 km for Caney Creek and 149 km and 17 km respectively for Upper Buffalo. On the worst days, the primary pollutants affecting visibility are sulfates, organic carbon, and nitrates. These visibility ranges reflect the emissions that are coming from industrial sources, such as coal fired power plants, pulp mills, etc.

The largest source of sulfates, nitrogen oxides and reactive organic gases in the project area are on-road motor vehicles. Particulates (PM-10 and PM-2.5) are emitted into the air by sources such as factories, power plants, construction activities, automobiles, fires, and agricultural activities. Most of the haze or smog that is visible within the project area moves into these higher elevations from valleys below. Emissions for the major sources of regional haze pollutants for Region 8 are listed below in Table 7.

Table 7: Sources of Regional Haze Pollutants

Regional Haze Pollutant	Anthropogenic Sources of Pollutant	Natural Sources of Pollutant
Sulfates	Coal-Fired Power Plants, Diesel Engines, Industrial Boilers	Volcanoes
Organic Carbon	Incineration, Household Heating	Fire, Vegetation
Nitrates	Cars & Trucks, Off-Road Vehicles, Industrial Boilers, Agriculture	Soils, Lightning, Fire
Fine Soil	Off-Road Vehicles, Agriculture	Wind-Blown Dust
Elemental Carbon	Soot, Diesel Engines	Fire
Fine Particulate Matter	Combustion Processes, Roads	Fire
Coarse Particulate Matter	Construction, Roads, Woodstoves Fireplaces	Wind-Blown Dust, Fire

Within the vicinity of the Ozark-St. Francis National Forests, a majority of the pollution is derived from the nearby urban areas. The greatest impact to area air quality from management activities on the National Forest comes from smoke. Unlike most industrial and urban sources, smoke is usually transitory in nature, lasting only a few days or weeks at a single location. However, in overall pollution loading, it can represent a substantial part of the uncontrolled pollution occurring in some air districts.

Direct and Indirect Effects

Alternative 1

There would be no direct effects associated with Alternative 1. Within the project area, 49,279 acres are approved for prescribed burning of between 12,000 and 15,000 acres annually under the *2009 Ice Storm Hazardous Fuel Reduction Project.* This project would continue to be implemented under Alternative 1; this level of burning is similar to that proposed under Alternatives 2 and 3, therefore smoke emissions for the no action alternative would also be expected to be similar.

Wildfires in the area would result in indirect effects to air quality. The acreage burned, tons of fuel consumed and quantity of emissions released in the event of a wildfire would depend on its intensity and the amount of time required to suppress it. With no control over weather conditions especially transport wind speed, wind direction, mixing height, stability class at the time of ignition, or the amount of fuel that may be consumed if the fuel moisture is low; the potential for impact on human populations and other smoke sensitive targets from wildfire smoke is high. Fewer emissions would be expected from portions of the project area treated under the *2009 Ice Storm Hazardous Fuels Reduction Project* than portions where those treatments had not been implemented.

Alternative 2

The proposed action is to use prescribed fire to treat an average of 15,000 acres annually in 22 areas across the Indiana Bat Habitat Restoration Project area to promote fire-mediated upland ecosystems. Burns would be conducted in coordination with the Arkansas-Oklahoma Interagency Coordination Center to help ensure conditions will support smoke dispersal. An average acres/year figure for implementation of this activity is used because these conditions may not occur on a sufficient number of days in some years to implement the level of burning anticipated to be needed to meet desired project objectives. In other years, ample days may be in prescription.

Burn unit sizes vary from 215 to 10,081 acres; each unit would initially be treated with a three to five year burn cycle until the reference condition (fire regime condition class 1) has been reached or the timeframe for implementing this project ends whichever comes first.

Based on existing air quality information from within the analysis area, regional air quality modeling projections, smoke dispersion modeling, and best available science; no long-term adverse impacts to air quality standards are expected as long as prescribed burning operations are conducted as designed. Air emissions from the proposed project would not threaten to lead to a violation of the federal Clean Air Act, nor any state or local air quality law or regulation.

There may be times when smoke from the proposed prescribed fires causes short-term respiratory discomfort, is a nuisance, or reduces visibility of those near the burn units. Although burns are planned to minimize these impacts to smoke sensitive areas and nearby residents, there is the potential for changed conditions after ignition to cause the smoke plume to shift direction and temporarily affect those in its path. These impacts are usually short-lived and last less than 24 hours. Impacts can occur some distance downwind depending on the weather conditions. This is particularly the case for burn units that may contain higher than normal fuel loads due to insect or storm damage where previous fuels reduction activities have not been implemented. For these reasons, smoke management planning is an integral part of each prescribed burn operation.

Prescribed fire emissions would have a direct, short-term effect on air quality in the project area. Once the smoke has dispersed, the impact is gone. The amount of smoke and how it is dispersed depend on the size of the burn, the type of fuel and the meteorological conditions at the time of the burn. In general, smoke from prescribed burning disperses into the atmosphere and combines with other existing pollutants. The wind transports the smoke and pollutants to areas many miles away where they are added to and possibly react with other gases/pollutants present in the atmosphere. The fate of emissions from prescribed fires is two-fold. Most (about 75 percent) of the emissions are "lifted" by convection into the atmosphere where they are dissipated by horizontal and downward dispersion from the fire. The balance of the emissions remains in intermittent contact with the ground. Ground level smoke does not have enough heat to rise into the atmosphere. It stays in intermittent contact with the human environment and turbulent surface winds move it erratically. Human exposure to ground level smoke can be more intense, relatively brief (hours rather than days) and limited to a smaller area than exposure from smoke aloft. Smoke aloft is already dispersed before it returns to the human environment while ground

level smoke must dissipate within that environment. Ground level smoke is dissipated through dispersion and deposition of smoke particles on vegetation, soil and other objects.

The direct effects of smoke include human health and safety issues (Hardy et al, 2001). Fine particulates, including those found in wildland fire smoke, can affect human health through the respiratory system, although eye irritation is also common. Individuals with cardiopulmonary diseases are especially susceptible. Residents near the burn unit and personnel conducting the burn might have some respiratory discomfort from ground level smoke, however it is expected that most impacts would be in the form of nuisance smoke and/or smell. For example, ash fallout can soil personal property and people may complain about the odors from the smoke. These impacts can be minimized by implementing the burn under weather conditions that are good for dilution and dispersion of the smoke away from smoke sensitive targets.

Herbicide application prior to burning will not affect air quality or human health. Forest Plan standard FW 153 states that no prescribed fires will be conducted in areas treated with herbicide until at least 30 days after the herbicide is applied. This waiting period is supported by results of a study of airborne herbicide residues in smoke from prescribed fires conducted in the southeast (McMahon 1992). No herbicide residue was detected after evaluating 140 samples from 14 operational burns, and the residue detection limit for the study was several hundred to several thousand times less than any established occupational exposure limit for herbicides. The sites in the study were burned 30-169 days following herbicide treatment.

Fine particulates can also reduce visibility at scenic views by scattering and adsorbing light. A sufficient concentration can result in a reduction in how far a person can see a distant object, and how well a person can see the color and texture of a distant object. Surveys indicate that viewing scenery is one of the main reasons people visit National Forests. The visibility impairment caused by prescribed fire is likely to be short term (less than 24 hours) in duration, and reductions in visibility (distance, color and texture) are likely to decrease as a person moves away from the prescribed fire.

Visibility on roads can be reduced by ground level smoke, causing a safety issue. This can be particularly bad if smoke continues into the night when emissions are likely to be trapped near the ground and slowly transported from the burned area. Smoke will follow drainages and collect in low lying areas. In a humid atmosphere the fine particles along with the water vapor released from the fuels can be a primary contributor to the formation of fog, which can become very dense. A person operating a vehicle in the vicinity of the prescribed fire may first experience good visibility conditions and then suddenly have visibility reduced significantly (perhaps to a few feet) when they drive into the fog formed by the smoldering emissions. Conditions like this can significantly increase the potential for highway accidents; however, the likelihood of accidents can be reduced by assisting vehicles driving through the fog or directing the traffic along a different route away from the fog.

The indirect effects of smoke are similar to the direct effects, but are experienced at greater distances from the burn. These effects are usually the result of the “lifted” portion of the smoke. Prescribed fires are managed to disperse and dilute smoke to avoid the negative effects of

emissions, especially downwind of the burn. Mass ignition techniques (such as aerial ignition from helicopters) that have become more commonly employed to treat more acres over a shorter time period and shorten the length of time that smoke remains in the vicinity of the burn. These ignition techniques, however, can also put more particulate matter into the atmosphere over a relatively short time. In some situations this increase in particulate concentration might be enough to cause already dirty air to violate air quality standards, affect human health or reduce visibility; and this can occur some distance downwind.

Dispersion modeling with the conservative screening model V-SMOKE (Lavdas 1996) was conducted for all of the proposed burn units in order to examine the potential for any impacts on downwind smoke sensitive targets. Meteorological parameters used for the modeling were estimates of expected conditions and not actual forecasts. Dispersion modeling conducted at this stage of planning is done to identify potential air quality problems, and to make recommendations for burn planning where air quality issues may arise. It is important to remember that modeling results are predictions based on assumptions. As the assumptions get closer to actual conditions, modeling results become more reliable.

Using worst-case firing scenarios and the regional minimum meteorological parameters, most of the units are predicted to result in downwind fine particulate matter concentrations outside of the Forest at levels that are of concern to the most sensitive populations. While most of the units have the potential to transport smoke beyond the National Forest at levels of that could be considered unhealthy for sensitive populations, potential impacts can be mitigated by burning with a wind direction away from the smoke sensitive targets. Table 8 summarizes the results of the dispersion modeling analysis; as shown, all burn units have the potential to cause “Code Orange” fine particulate matter concentrations outside of the National Forest. Additional information is included in the project planning record.

Table 8. VSMOKE modeling results for the 22 proposed burn units, based on worst-case firing and meteorological parameters.

Burn Unit Name	Burn Unit Acres	Predicted Downwind Extent for Fine Particulate Matter Concentrations (in miles)	
		Code Red or Worse (Unhealthy for All)	Code Orange (Unhealthy for Sensitive Populations)
Bad Branch	3120.58	62.14	>62.14
Barkshed	10080.80	62.14	>62.14
Bearhead Branch	5850.20	7.82	15.61
Bearhead 2	2318.94	39.21	62.14
Bear Pen	4050.53	39.21	62.14
Bethel Springs	416.79	15.61	24.74
Blanchard	3929.43	62.14	>62.14
Brewer	215.30	7.82	12.40
Capfork	642.33	15.61	31.14
Caroline Gap	2643.38	62.14	<1
Cartwright	4184.22	62.14	>62.14
Experimental Forest	4301.73	62.14	>62.14
Fifty Six	2772.88	62.14	<1
Green	1370.11	4.94	9.85
Green 2	2102.30	62.14	>62.14
Livingston	1181.10	31.14	62.14
Optimus	3146.70	62.14	<1
Rorie	5143.56	62.14	>62.14
Sugarloaf	5871.44	62.14	>62.14
Sugarloaf 2	84.80	7.82	9.85
Tablerock	904.62	24.74	39.21
Tarwater	2774.15	62.14	<1

An indirect effect of prescribed burning on air quality would be a reduction in emissions resulting from wildfire. The acreage burned, tons of fuel consumed and quantity of emissions released during a wildfire would be dependent on the amount of time required to suppress it. When hazardous fuels are removed through prescribed burning, potential severity of wildfire and associated emissions decrease. Emissions from wildfire generally affect human health and visibility conditions much more than prescribed fire emissions, because there is no control over conditions affecting fire behavior and smoke dispersion.

To minimize the negative effects of smoke and associated pollutants on visibility and human health, smoke management plans are required as part of every prescribed fire implementation project. Implementing these requirements does not completely eliminate the risk of smoke impacts from prescribed fire; unforeseen changes in weather and equipment failures can cause unanticipated smoke intrusions.

Strategies can be implemented to reduce the amount of smoke emissions. These include avoiding burning when smoke would not disperse well or would carry into a smoke sensitive area, and reducing smoke concentration by staggering ignitions and/or burning when there is good smoke lift and dispersion.

For some treatment units, even the most diligent planning will provide no option that can avoid all smoke sensitive targets. In these cases the project can be modified or the District will seek ways to mitigate the impacts of the smoke.

Alternative 3
Under this alternative, timber stand and wildlife stand improvements would be conducted through manual, mechanical and burning treatments only. Everything else would be the same as Alternative 2; therefore direct and indirect effects to air quality will be the same as those described for Alternative 2.

Cumulative Effects

Alternative 1
There would be no cumulative effects associated with Alternative 1. However, air quality and standards in the analysis area would continue to be affected by all other sources of air pollution.

Alternatives 2 and 3
Cumulative effects of this alternative would likely add smoky days in the area on a yearly basis. There are a limited number of days each year with conditions that support smoke dispersal, where conditions on the ground will carry fire, and where adequate fire-qualified staffs are available to conduct a burning operation safely; therefore, for most of the days when these conditions exist, prescribed burns across all ownerships are likely to be conducted. Within the project area, any burning activities conducted would count toward the average acres burned each year for this project; therefore there would be no additional cumulative effect where other project areas overlap. Areas approved for prescribed burning outside the project area boundary would still be burned under their respective National Environmental Policy Act decision documents.

Both alternatives will reduce the potential for occurrence of a crown fire which would tend to release high amounts of PM-10 and PM-2.5 better than Alternative 1. Alternatives 2 and 3 each provide for 3,500 acres per year of commercial thinning actions that would remove timber from the area. Alternative 2 provides for an additional 4,000 acres of thinning through timber stand and wildlife stand improvement treatments combined, while Alternative 3 provides for up to 8,000 acres of thinning through those treatments. Removals will reduce the amount of available fuel and ladder fuel in the project area; felling will reduce ladder fuel, but will increase the amount of available fuel on the ground. Therefore, Alternative 3 will add more available fuel to the project area than Alternative 2 will.

All prescribe burning on the District will be done in accord with the Smoke Management Program to mitigate the potential for negative cumulative impacts to area air quality. The

Arkansas-Oklahoma Interagency Coordination Center coordinates prescribed fire activities, including those conducted by the AR Forestry Commission on private land. Smoke Management Program guidelines include notifying the Arkansas-Oklahoma Interagency Coordination Center and performing a smoke dispersion modeling analysis prior to ignition. If the fuel tonnage for a prescribed fire within a given air shed exceeds permissible limits, the Arkansas-Oklahoma Interagency Coordination Center will recommend to the prescribed fire manager that the burn either be delayed or the planned acreage to be burned be reduced.

Climate Change

Climate change can be considered from two perspectives, 1) the impacts of climate change on forest resources, and 2) the impacts of the project on climate (US Forest Service 2009). The first perspective is considered elsewhere in this chapter, when it is relevant to cumulative effects on specific resources. As background to those discussions, note that the average monthly precipitation amount will likely decrease slightly while temperatures are expected to increase by 1.7^{o} to 3.0^{o} Celsius over historic ranges. These changes are comparable to expected changes in regional and national averages (US Forest Service 2012).

With regard to the second perspective (project impacts on climate), impacts would come through the emission or sequestration of greenhouse gases, such as carbon dioxide. Consequently, it is not possible to make specific predictions about the effects of the proposed action or alternatives on climate. Emissions or sequestration attributable to this project would be lost among the many other variables affecting greenhouse gases, such as global economic trends. That is why, for instance, the Intergovernmental Panel on Climate Change describes scenarios with markedly different projections of greenhouse gas emissions, as it is difficult to predict trends at the global scale. Currently, trends are most consistent with high-emissions scenarios, i.e. A1F1 and A2 (US EPA 2013a; Intergovernmental Panel on Climate Change 2007).

In 2011, overall land use, land use change and forestry activities offset 14.9% of total U.S. carbon emissions (US EPA 2013b: 7-1). Since the scale of proposed activities is within the scope of past and current activities on the Ozark-St. Francis National Forest, the proposed activities would not be expected to alter national, much less global, emission or sequestration patterns in a noticeable way.

Direct, Indirect and Cumulative Effects

Alternative 1

Because no action would take place under this alternative, carbon would continue to be sequestered and emitted in line with historic patterns. As forests mature, the rate of sequestration declines; in some cases unmanaged, older forests can become net carbon sources, especially if potential loss due to wildfires are included (Malmsheimer, Heffernan, Brink, et al. 2008). For the Ozark-St. Francis National Forest, growth of forest carbon stocks levels off when stands reach 50 to 60 years old (Cole Development Group 2013: Table 1). The rate of sequestration declines and levels off correspondingly.

Alternatives 2 and 3

The proposed harvest operations associated with these alternatives would result in a release of carbon and reduce carbon storage in the forest both by removing organic matter (trees) and by increasing heterotrophic soil respiration. For instance, forests on the Ozark-St. Francis have, on average, 96.51 tonnes of non-soil carbon per hectare at 100 years of age, and 19.37 tons of non-soil carbon at 5 years of age (Cole Development Group 2013: Table 1), although some of the carbon that is removed is offset by storage in forest products. Prescribed burning activities

would also release carbon dioxide, other greenhouse gasses and particulates into the atmosphere, although implementing the proposed prescribed burns on a 3 to 5 year cycle would reduce fuel loading and could be expected to reduce fire intensity and severity as well.

Indirectly, implementation of these alternatives would increase the overall health, vitality, and growth within the project area, reduce the susceptibility to insects and disease, as well as reduce fuel accumulations and lower the risk for a catastrophic wildfire from occurring in the project area (see the 'Major Forest Communities' discussion in the following section). This would be consistent with recommended practices to mitigate potential emissions (Millar and others 2007: 2149).

For the reasons described in the introduction to this section, the selection of an alternative for this project, including the no action alternative, is not expected to have any discernible effect on climate.

BIOLOGICAL ENVIRONMENTS

Major Forest Communities, Rare Communities and Non-Native Invasive Species

Major Forest Communities

Major forest communities are determined by species composition and site conditions; they include abundant community types as well as those uncommon types that are not considered rare or special communities. Though the desired future conditions for each community vary, they are consistent with the desired conditions for this project. Because treatments will be limited to the project area boundary, it will serve as the analysis for the direct and indirect effects. Because the proposed treatments will affect forest health, the analysis area for cumulative impacts will include all National Forest acres on the Sylamore Ranger District. The timeframe for this analysis will be 12 years for direct and short term indirect effects. Long term indirect effects and cumulative effects will be realized over decades beyond the timeframe for this project.

Approximately 64,468 National Forest System acres within the project area are forested. Non-forest lands include managed wildlife openings and range allotments, waterbodies, and road corridors. The major forest communities within the project area are listed below in Table 9:

Table 9: Major Forest Communities within the Indiana Bat Habitat Restoration Project Area

Major Forest Community	Desired Conditions Described in the Forest Plan on pages:	Approximate Percentage of Forested Acres within the Project Area
Dry Oak Forest and Woodland	1-20 through 1-22	68%
Shortleaf Pine-Oak Forest and Woodland	1-22 through 1-24	23%
Dry-Mesic Oak Forest	1-24 through 1-27	9%
Mesic Hardwood Forest	1-27 through 1-28	<1%
Riparian Forest	1-28 through 1-29	<1%
Loblolly Forest	1-29 through 1-30	<1%

The Dry Forest and Woodland Community is the most abundant covering approximately 68 percent of the proposed project area; approximately 36 percent of this major forest community is over 100 years old and less than 1% of it is in the 0-10 year age group. The second most abundant community is the Shortleaf Pine-Oak Forest and Woodland; the majority of this community is between 81 and 90 years old and like the Dry Forest and Woodland Community, it also lacks an early regeneration age component. Riparian areas are generally in a mid-to late-successional stage of forest development. Loblolly Forest is not native to the Ozark National Forest. It dominates the overstory on approximately 25 acres of the project area.

Across all communities, advanced regeneration of dominant overstory species is lacking. Factors contributing to this condition include:

- Limited sunlight to the forest floor due to closed canopies;
- Poor mast production due to advanced age, crowded growing conditions, and ice damaged crowns;
- Heavy leaf litter that contributes to desiccation of seedlings, and
- Competition with dense, shade tolerant stems.

If a stand replacing event occurs, shade tolerant species with fast growth rates will outcompete slow growing oak and hickory forest types.

Table 10 shows the approximate distribution of successional stages of forested acres in the project area.

Table 10: Approximate Age Class Distribution of Forested Acres within the Indiana Bat Habitat Restoration Project Area Based on Existing Available Data

Age Group *(years)*	0-10	11-20	21-30	31-40	41-50	51-60	61-70	71-80	81-90	91-100	100+
Acres	447	921	2720	2466	3671	1515	1652	4883	12032	11238	23817
% *(rounded to the nearest tenth)*	<1	1.4	4.2	3.8	5.6	2.3	2.5	7.5	18.4	17.2	36.4

The dominant overstory species of the project area—White oak, hickory and Shortleaf pine—are fire-resistant species [Dey (2002) and Brose et al (2005) in Dey and Fan 2009]. Spetich et al (2004) describes human influences on fire regimes over the past several thousand years in the hardwood forests of eastern United States with emphasis on the Central Hardwood Region. Use of fire by Native Americans had a major influence on vegetation of eastern North America from 12,000 to 400 years before present. Open forest and woodland conditions were common. Disruption of the fire regime that influenced development of oak and hickory dominated forest communities began after European settlement of the area. Foti (2004) examined General Land Office records from the early and mid-nineteenth century which describe densities of 124 to 133 trees/hectare or approximately 50 trees/acre. Fire suppression policies of the early 1900s lasted for nearly 80 years. An increased number of trees per acre, advanced stand age, a lack of successful regeneration and recruitment of oak into forest overstories, reductions of early successional habitat and increased dominance of shade-tolerant species have resulted over the last century.

Oak decline is a normal part of the ecosystem processes in aging hardwood stands; all oaks are host species. Mortality is highest on coarse, rocky, shallow soils of site index 70 or less. Factors such as advanced stand age and high stand density influence oak decline; periodic large-scale episodes are often associated with drought. The Ozarks experienced a severe drought period from 1998 to 2000 and a mild drought period in 2005 and 2006 (Spetich and others 2011). The

proposed project area occurs in an area that was considered to be in an exceptional drought in 2012 (http://droughtmonitor.unl.edu/pdfs/south_dm.pdf). In 2000, the Ozark National Forest was in the midst of a major oak decline event. Numerous years of drought conditions and an abundance of overstocked, old stands created thousands of acres of highly susceptible forest. These conditions likely led to an unprecedented outbreak of red oak borer adding additional stress to affected stands. Pelkki (2005) estimated this insect had killed nearly one-third of red oaks in the state. The cumulative impact of droughts on red oak decline and mortality might last up to 10 years based on the past 17 years' Palmer Drought Severity Index.

Other events that can incite oak decline include repeated defoliation by insects or injury from frost, ice, or wind. Once oaks begin to decline, they become susceptible to other diseases and insect pests that cause further stress, damage or mortality. Symptoms of oak decline are evident throughout the project area.

District-wide, over 100,000 acres were affected by the 2009 ice storm; the project area includes some of the hardest hit areas. Gaps in the canopy exist where ice accumulations broke crowns and stems or up-rooted larger crowned trees.). Field examinations completed since 2009 show these gaps were primarily located on the shoulders or back-slope of slopes. Other trees were damaged and weakened; the vase-shaped form of many elms and oaks has been identified as particularly susceptible to ice damage (Rogers,1924; Reed, 1939; Van Dyke, 1999)

Stressed trees and woody debris serve as host material for several insect pests and diseases. Based on known biology of organisms and the commonly observed activity that occurs on damaged trees and woody debris after such an event, it is plausible that secondary impacts from insect attacks and disease outbreaks will occur. The severity of damage to an area will determine the risk of insect and disease problems. Areas with slight damage have a lower risk of insect and disease problems. Moderate to severely damaged areas will have a higher potential for problems. These secondary impacts can appear immediately and persist for many years or manifest gradually with delayed impact. [(USFS Petty 2009; Bragg et al 2003)]. Tables outlining the most likely insects and diseases that could impact storm damaged areas on the District are provided in Appendix G of this Environmental Assessment. Ice damage is mapped in Appendix B.

The midstory and ground vegetation components and densities are typical of those found in the cover types of the area. The species composition in the mid-story consists of oak, hickory, dogwood, persimmon, sassafras, sweetgum, locust, blackgum, elm, pine, redcedar, and red maple. Common shrubs found in the project area are French mulberry, hawthorns, blueberries, viburnums, greenbriers, blackberry, honeysuckle, and grape. Grasses and other herbaceous vegetation in the understory include bluestem, foxtail, nutsedge, poison ivy, desmodium, and panicums. Where canopies are closed, reduced sunlight, dense under and midstory vegetation and buildup of duff or needle layers are reducing or possibly eliminating the survival and growth of grasses, forbs, and seedlings.

The majority of the proposed project area consist of fuels that make-up Fuel Model Nine (9) (National Forest Fire Laboratory fuel models) characterized as mixed hardwood-pine-oak litter.

Closed canopy stands of short-needle conifers or hardwoods that have leafed out support fire in the compact top layer of litter comprised mainly of needles, leaves, and some twigs. Prescribed burns have been applied in some areas to reduce hazardous fuel loads, but not at intensities or return intervals that would affect canopy closure or reduce shade tolerant stems competing with regeneration. Because stressed trees will continue to die, it is expected high levels of available fuel will persist for several years.

Invasion of non-native invasive plants into forests of the Southern United States continue to spread and new species are constantly being introduced. These invasions erode forest productivity, hinder forest use and management, and degrade diversity and wildlife habitat (Miller et al 2010b). Disturbances caused by management such as harvesting and use of prescribed fire can facilitate further spread by exposing soil, increasing sunlight to the forest floor and stimulating seed to germinate.

Direct and Indirect Effects

Alternative 1

Alternative 1 would implement no new management actions in the area. Therefore, there will be no direct effects if it is selected. Existing vegetation will continue to grow, and there would be little or no substantial short-term effects on vegetation. Over the long term, the imbalance in the distribution of successional stages will continue to be skewed towards the older age classes. As the forest within the project area ages, resilience to environmental stressors will decline further.

Areas experiencing oak decline will not be improved because no areas will be regenerated and competition between trees will not be reduced. Existing conditions do not favor regeneration and recruitment of oak and hickory forest types into the overstory, so a gradual shift in species dominance and stand composition toward shade tolerant species would be expected. The shift would occur more rapidly if a stand replacing disturbance occurs.

Actions conducted under the *2009 Ice Storm Hazardous Fuels Reduction Project* have reduced the amount of host material and available fuel from portions of the project area—including woody vines that increase the ice accumulating surface area or cause constriction-related defects in the stem (Siccama et al., 1976) and ladder fuels which could carry fire into the crowns. Treatments to reduce competition between young regeneration and shade-tolerant species are limited to the Rorie and Sugarloaf project areas. The *2009 Ice Storm Hazardous Fuels Reduction Project* will not effectively reduce competition for oak, hickory or Shortleaf pine regeneration—especially those stems that are sufficiently large enough to re-sprout with vigor after top-kill by a burn.

Alternative 2

Under this alternative, vegetation within the project area would be manipulated to

- shift overstory density toward the optimal summer habitat ranges for the Indiana bat described in Forest Plan standards FW 47 and FW48 respectively;

- promote regeneration and recruitment of oak, hickory and shortleaf pine to the overstory to provide a continual supply of roost trees for the Indiana bat;
- create a mosaic of ages and structure that are more resilient to impacts of insect and disease outbreaks, wildfire or other environmental stressors than the existing condition.

Treatments across the project area will not, nor are they intended to result in a homogenous condition within the conservation zones. Optimal overstory densities are described as a range across a portion of the project area. Not all areas with potential to receive different treatments as shown on the Proposed Vegetation Management Map in Appendix B will actually receive all of those treatments. For example, not all available treatments may be needed to bring some portions of the project area closer to desired conditions, and site conditions in other portions of the project area may either preclude the safe implementation of some treatments or limit their effectiveness such as the ability of fire to carry through moist areas. The activities proposed for this entry therefore, will not result in achieving optimal overstory density requirements for the Indiana bat across the entire project area, but that objective will be fully met in some areas and closer to being met in others when compared to the existing condition. For this project management with the even- age silvicultural system will most likely be continued. Single tree selection will not open the canopy enough to recruit oak-hickory forest types into the overstory (Dey and Fan 2009). This will not preclude use of an uneven-age silvicultural system in the future or the use of single tree removal harvests where appropriate for this project. For example, it would likely be used in riparian areas or in some areas with high scenic value.

The direct effects of actions involving cutting, burning and herbicide use are immediate reductions in density and diversity within the treated areas. Canopy gaps will be created primarily in areas involving removal of overstory trees, during future entries, Forest Plan requirements will ensure prescriptions will include actions to maintain these openings or to create new ones to ensure summer habitat conditions for the Indiana bat are provided. When regeneration harvests are implemented there will be an immediate increase in the amount of early seral habitat. The direct effect of reforestation is that desired levels of stocking outlined in the Forest Plan will immediately be realized in areas receiving that treatment.

Reductions in density and diversity will be temporary. Commercial and non-commercial thinning treatments will reduce basal area by removing suppressed, intermediate, and some dominant and co-dominant stems. These treatments will provide additional light and growing space for trees, seedlings and saplings that remain on the site. Thinning will also increase the potential for development of larger crown size and diameter at maturity thus improving the potential for mast production. Competition between stems will be reduced after commercial and non-commercial thinning treatments are implemented leaving the area more resilient against insect and disease infestations than it is currently. Reducing stand density will be especially beneficial to residual stems on drier, low quality sites and in areas where trees are stressed due to ice damage. Conditions stimulating growth of flowering plants, bulbs, grasses and forbs in the understory will also be enhanced; species richness will therefore, increase.

Following regeneration harvests, all successional stages will be better represented within the proposed project area (and ultimately across the District) than they are currently; the increase would be limited to no more than 10 percent of the National Forest acres within the project area,

so most of the area will continue to be over 70 years old. Regenerating areas will be limited in size and will be distributed as outlined in the Forest Plan. Some of the areas experiencing oak decline or that were severely impacted by the ice storm will be replaced with vigorously growing trees; risk of widespread damage and loss from insects and disease outbreaks therefore, would be decreased because healthy "pockets" will be created amongst the contiguous blocks of older trees and will serve as breaks against the spread secondary impacts from decline or damage. Over time, the regenerated areas will progress toward a mature condition and serve as roost trees for the Indiana bat.

Indirectly, being able to respond to disease or insect infestations as they are discovered will help to limit the extent to which those infestations spread.

Herbicide applications are the most effective way to control trees that were established during decades of fire suppression; they represent efficient and cost effective methods to achieve desired objectives. For this project up to 8 percent of the National Forest Service acres within the project area boundary may receive a herbicide application each year over the next 12 years. Once sites have received timber stand or wildlife stand improvement treatments with herbicide, additional treatments of similar extent are not likely to be necessary for several decades. As stated previously in this document, the majority of timber stand improvement and wildlife stand improvement treatments will be selective and non-contiguous and will not affect seed stock of targeted species. Forest Plan requirements, the herbicides selected for use, the methods of and conditions for application will all reduce the potential for off-site movement and effects to non-target vegetation. Any effects to non-target vegetation therefore are expected to be nominal, limited to the treated areas, and temporary—lasting only until seed germinates and new growth occurs. The effects of herbicide treatment on vegetation are further discussed in their respective risk assessments.

Periodic underburning in mixed hardwood stands creates conditions similar to those prior to fire exclusion and are conducive to oak regeneration and establishment (Van Lear, D.H. 2002). Research has shown that prescribed fire can help prepare the seedbed for acorn caching by wildlife, xerifying or drying or drying the soil surface to inhibit establishment of mesophytic species, and decreasing populations of acorn infesting insects (Brose in press in Spetich 2004).

Dey and Fan (2009) reviewed key fire effects on oak regeneration from acorn germination to seedling establishment and development; removing some of the litter layer through burning in combination with commercial and non-commercial thinning will provide more favorable conditions for acorns, hickory and shortleaf pine to germinate and survive. Fire that reduces litter and duff layers to less than 2" thick before autumn acorn and leaf drop favors oak seedling establishment; this benefit lasts between 3 and 4 years following a burn.

Regeneration requires sufficient light to build root systems with high carbohydrate reserves that support rapid shoot growth following disturbance events; oak species require 30 to 50 percent of full sunlight for good growth. Prescribed fire alone is not likely to achieve this result where canopies are closed. Growing season burns would reduce the amount of litter and would remove woody vegetation competing with advanced regeneration (>2 ½ feet tall) of dominant forest

types in the under- and mid- story; spring burns can remove up to 50 percent of the midstory. More available fuel and host material will be removed in the project area through this alternative than the no action alternative because more of project area will have potential to be treated with fire. Studies cited in Dey and Fan 2009 indicated only after repeated fires (annually up to 5 years) do tree species begin dropping out of mature forest understories or young stands. Oak reproduction is better adapted than many of its woody competitors because it has numerous dormant buds near the root collar which is often buried in the soil and protected from surface fire.

Canopy closure will be measured within one year following completion of activities with potential to affect overstory density. Data collected will help managers determine if additional treatments are needed to achieve the desired percent canopy closure and will be useful in prescribing or adjusting treatments on sites with similar pre-operation conditions. The immediate effect of project actions on desirable regeneration will be determined through required Forest Service certification checks. Long term effectiveness will be determined during field examinations that occur approximately every 10 years when conditions will be updated by a certified prescriber.

Some of the standing timber damaged by the ice storm would be removed from the proposed project area through harvest. The amount of damaged timber removed through harvest will depend on whether

- it occurs in a green sale unit;
- it poses a safety hazard;
- it is in an area where an insect or disease outbreak has been identified or
- it is accessible.

The season in which it is removed will also be determined by results of surveys to determine presence or probable absence of Indiana bats. It is neither desirable nor feasible to remove all merchantable dead wood in the project area. Dead standing and down wood are important components of the ecosystem. These components contribute to forest biodiversity by providing habitat and food for numerous terrestrial species, and play important roles in carbon cycling and in the function of riparian systems. When incorporated into stream channels, dead wood helps to provide habitat for aquatic species. While burning will consume some dead wood, it will not consume all of it and it will also create new snags in some areas. An average of at least 9 large diameter standing dead or dying trees with exfoliating bark will be retained on site to ensure suitable roost trees are available for the Indiana bat; where this snag density does not exist, it can be created by girdling suitable trees.

Harvested stems will be removed and some woody debris will be reduced through burning or structurally modified through mechanical treatments. Therefore, it can be expected that the resulting impacts of a wildfire (severity) in a treated area would be less severe than those of a wildfire in an untreated area. For Fuel Model 9, slow-burning ground fires and low flame heights are the typical rule, but higher intensity fires can result under severe weather conditions. Conditions that contribute to severity are combinations of low relative humidity, wind speeds over 10 miles per hour (measured at 20 feet), drought or drier than normal large fuels, and

temperatures over 80 degrees. Prescribed burns would not be implemented when these conditions are aligned.

The proposed activities have potential to damage residual stems, but compliance with Forest Plan standards, project design and supervision of vegetation management actions help to limit those effects.

- Supervision by trained Forest Service personnel helps ensure Forest Plan and contract requirements are met to limit damage to residual stems from tree fall or equipment, to reduce the potential for negative effects to non-target vegetation and to reduce the potential for spread of non-native invasive species. In the event of an accidental herbicide spill, the person or persons supervising an operation will ensure the Ozark-St. Francis National Forests' Pesticide Emergency Spill Plan is implemented to minimize the extent of the spill.
- Fire scarring will occur on individual trees with prescribed fire treatments; the level of fire scarring on residual timber and subsequent extent of secondary effect cannot be quantified as they are influenced by numerous conditions. Under prescribed conditions, healthy large diameter hardwoods are not likely to be killed outright by burning, but fire scars could provide points of entry for insects and disease. Managers take several variables into account when planning prescribed burns to meet a particular objective. These include but are not limited to fuel type, fuel load, fuel moisture, humidity and air temperature; they also take into consideration the firing pattern and technique most likely to produce the desired result and to protect resources. Forest Plan standards applicable to prescribed burning further limit the potential detrimental effects such as removing too much of the protective litter and duff layer or causing excessive fire scarring.
- Foliar applications to treat some non-native invasive species infestations, such as Sericia lespedeza along roadsides or to remove shrubby vegetation in regeneration areas will kill individual non-target plants, but will not kill seed stock in the soil.

<u>Alternative3</u>
Herbicides would not be used to implement timber stand improvement, site preparation or wildlife stand improvement treatments, but the effect of these treatments on density, structure, quality and composition would be expected to be the same as would the effects of tree removal, prescribed fire and non-native invasive treatments.

Without the use of herbicide, competition would be reduced through a combination of repeated mechanical, manual and prescribed burning treatments until residual stems are free to grow. Site conditions will influence the number of entries needed to achieve this result. On dry sites it might only take a single release treatment 3 to 5 years after regeneration is established to achieve the desired effect. As sites go from dry to moist conditions, competition and growth of woody stems increases, so multiple release treatments at years 4, 8 and 14, for example, would be needed to achieve a similar result.

Prescribed fire would play an important role in keeping woody competition controlled to support recruitment of regeneration into the overstory. In areas where there is sufficient advanced regeneration to meet stocking levels identified in the Forest Plan, fire would be applied at regular

intervals in order to keep competition in check. Prescribed fire within two years after a release treatment would be beneficial because it would result a temporary reduction of competition with oak-hickory and Shortleaf pine regeneration.

Release in young stands with manual or mechanical treatments will improve growing conditions for the remaining trees, but may not necessarily improve ground level light conditions. Applying growing season prescribed fire following a release treatment will remove additional stems of competing species to increase light to ground level and stimulate growth of grasses and forbs.

Cumulative Effects

Alternative 1
Because no new actions will be implemented under Alternative 1, no cumulative effects are expected.

Vegetation management actions within the project area boundaries approved under the *2009 Ice Storm Hazardous Fuels Reduction Project, the Rorie Project and the Sugarloaf project* will provide some benefits to forest health by reducing competition for residual stems and removing fuels and host material through timber sales and prescribed burning. These actions are not approved for the entire *Indiana Bat Habitat Restoration Project* area. However, these projects will not greatly improve the potential for a continual supply of roost trees in the future. The *Sugarloaf Project* and the *2009 Ice Storm Hazardous Fuels Reduction Project* do not include any regeneration cuts. The *Rorie Project* only includes 391 acres of regeneration harvests. Recruitment of natural regeneration to the overstory is doubtful where these projects and the *Indiana Bat Habitat Restoration Project* areas overlap, as the majority of timber stand improvement actions planned under the *Sugarloaf* and *Rorie* projects have already been implemented.

There would be no potential to improve forest health on adjacent private land through formal agreements with willing landowners.

Alternatives 2 and 3
The project area covers nearly two-thirds of the District. Therefore, the health and vigor of the majority of the District will be improved to varying degrees under both action alternatives. All successional classes will be better represented than they are presently and a mosaic of young regeneration mixed in with areas of older age classes will exist. Breaking up large areas of a uniform age class will help to reduce the impacts of insect and disease attack by creating a more resilient and sustainable ecosystem that should provide suitable foraging and roosting habitat for the Indiana bat and other species into the future.

Rare Communities

Rare and special communities are assemblages of plants and animals that typically occupy a small proportion of the landscape, but which contribute significantly to plant and animal diversity because of the number of rare species associated with them. They typically are limited

in number of occurrences, are small in size, and have relatively discrete boundaries. Some plant and animal species may live exclusively within a respective rare community type; others may just rely on it for part of their life cycle or prefer it over other habitats.

These communities have been identified and defined primarily using the International Ecological Classification Standard developed by NatureServe. Rare communities that are within the project area or have the potential to occur within it include glades and barrens, cliff and talus, caves, mines and karst, natural ponds, ponds-lakes-waterholes, seeps and springs, and canebrakes.

Adequate baseline information for most of these communities is currently lacking. General descriptions for each of these will be presented here. Additional information is provided in the project planning record.

Glades and Barrens

Glade communities are characterized by thin soils and exposed parent material that result in localized complexes of bare soil and rock, herbaceous and/or shrubby vegetation, and thin, often stunted woods. They vary in species composition depending on the type of underlying parent material, which may be acidic or calcareous. Field delineations of these communities include the entire complex of characteristic vegetation composition and structure, and where practicable connecting woodlands. Periodic vegetation management, especially prescribed fire, may be necessary to maintain or restore desired herbaceous and/or shrubby composition. These communities are comprised of the following Ecological Systems as defined by NatureServe: Central Interior Highlands Calcareous Glades and Barrens (CES202.691) and Central Interior Highlands Dry Acidic Glades and Barrens (CES202.692).

These communities harbor a variety of desert-adapted species that do not occur in other habitats in the Ozark-Ouachita Ecoregion. These plants and animals are remnants of a period spanning approximately 8,000 years that was hotter and dryer than today's climate. A common misconception is that the term "glade" refers only to an exposed area of rock with sparse soils; while these areas are easily recognizable, they represent only a part of this rare habitat type. Soils get gradually deeper moving from the exposed rocky portion of a glade outward; as soil depths increase, changes in vegetative cover are seen. Glades, therefore, will also include open, grassy areas surrounding the exposed rock and open wooded areas that eventually transition to the forest.

The most extensive glades on the Ozark National Forest occur in the Springfield Plateau Area of the Sylamore Ranger District. Since 2011, the Nature Conservancy has been conducting a glade assessment on the District. The entire project area has been surveyed; nearly 6,000 acres within it that qualify as glade ecological classification (personal communication – Doug Zollner, The Nature Conservancy). These areas are illustrated in figure 5.

The District glade assessment has not been completed; the quality of habitat provided by project area glades, however has been characterized based on three variables: density of cedar, presence of non-native species and noticeable occurrence of fire as shown in Table 11 below. The

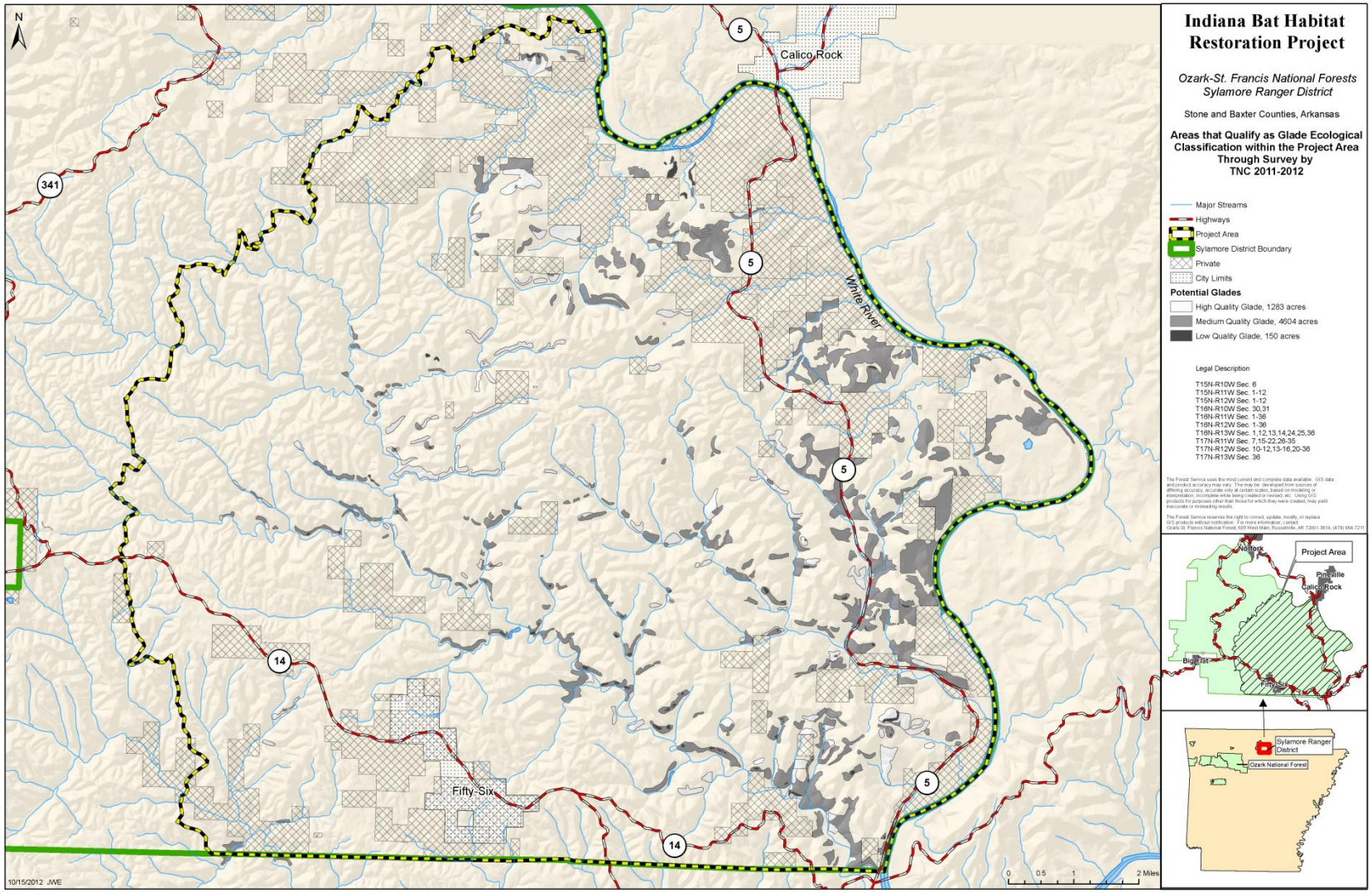
majority of glade habitats within the project area are degraded to some degree; factors leading to the current condition included past land uses (such as grazing during the settlement period) and years of fire exclusion which led to the encroachment of red cedar, a fire intolerant species.

Table 11: Approximate Acres of High, Medium and Low Quality Glade within the Indiana Bat Habitat Restoration Project Area Based on Surveys Conducted Between 2010 and 2012 by the Nature Conservancy

Quality	Criteria	Approximate Acres
High	<25% cedar; no non-native species; visual evidence of fire	1,283
Medium	Cedar cover between 26 and 50%; scattered non-native species or visual evidence of fire	4,604
Low	All other conditions	150

Trelease's larkspur, bush's yellow coneflower, and small-headed pipewort are plant species of viability concern found in glades. Open woods and talus areas often connect glades allowing for animal species to move among glades. This is the case with the eastern collared lizard, a glade obligate which will not travel through the shaded conditions found in forests. Current conditions have isolated populations of this lizard into small patches of habitat that make them vulnerable to local extirpation. This species has disappeared from many of the glades that they once inhabited. Other animals that are not glade-dependent use glade habitats for critical periods of their lives. Wild turkeys, for example, are likely to use glades for brood rearing.

Figure 5: Areas that qualify as glade ecological classification within the Indiana Bat Habitat Restoration Project Area



Cliff and Talus

Cliff and talus areas are fully functioning ecosystems that provide for the full range of native species associated with this community type. Little soil is found in these areas. Talus slopes are steep slopes of exposed chunks of rock at the base of a cliff or steep mountain that offer both basking sites and crevices for hiding for animal species. Cliffs are faces of vertical exposed rock that sometimes have a talus slope at their base. The most successful types of species in these habitats include lichens, mosses, ferns, reptiles, some species of bats and birds and small mammals. Some cliff and talus areas are prone to periodic fire and others are in moist areas that have seen very little fire in the past. Threats to cliff and talus sites may primarily be the threats to the surrounding forested areas which provide for effective dispersal and mixing of wildlife species that typically inhabit these areas.

The project area contains many cliff and talus areas, but the exact distribution of this community type is not known. These areas can be extensive, and are often associated with glade habitats above them. Records of surveys and/or inventories of cliff and talus habitats were not found in the District records; therefore, it cannot be determined what the current conditions are. The desired conditions for cliff and talus habitats include optimum habitats for a unique variety of animals and both sun-loving and shade-loving plants maintained with fire return intervals of every 3 to 7 years.

Caves, Mines and Karst Habitats

Caves are characterized by openings in the ground that extend, for the most part, beyond the influence of sunlight and weather, creating habitats buffered from the surface environment. The desired condition for the caves and karst habitats would be that all are fully functioning ecosystems with properly maintained hydrology, are able to provide habitat for the full range of native species associated with the systems, and are protected from detrimental human disturbance. Caves may contain a variety of microhabitats including streams, pools, wet stone, and mudflows along with dry rock and mud banks. Cave faunal assemblages vary widely within and between caves depending on microhabitats and history of connectivity between and within cave systems. A variety of terrestrial wildlife species utilize caves, particularly during winter months. The Indiana bat and other bat species rely on undisturbed caves for winter survival. Graening and others conducted an inventory and assessment of caves and subterranean passageways on the District between 2000 and 2002 and several new species were described. Because these inventories were not complete, it is plausible that other unidentified species exist.

Included and inseparable from caves are other karst features including sinkholes and sinking streams that lead to subterranean environments. Surfaces of karst lands are directly linked to subterranean cave water systems and aquifers. Underground aquatic systems contain their own community of organisms. A large natural sinkhole occurs on one of the District's range allotments in the project area. The water level in this sinkhole-pond rises and lowers with the water table.

Abandoned mines often offer habitat for cave species. Old mines zinc mines occur within the project area, but it is unlikely they offer suitable cave-like habitat because they were generally excavated parallel to the ground and so close to the surface they have collapsed, leaving only a shallow depression with no cavity space. Some shafts were constructed vertically, but these are very narrow and have also been found filled with water, making their suitability for cave species doubtful.

Natural Ponds

Natural ponds on the Forest consist of depressions that hold water for varying periods of time. They are very rare on the Forest today and provide islands of diversity in the uplands and are important for bottomland plants, as breeding sites for amphibians, and as drinking sites for terrestrial animals. These areas were more prominent in the past but most were converted to permanent improved ponds at the time of settlement. Natural ponds typically go dry for part of the year. This prevents fish from becoming established and improves the site for many amphibian species that depend on fluctuations in the water level and cannot thrive under predation pressure from fish. Water depth may vary greatly on a seasonal basis, and may be a meter deep or more in the winter. Some examples become dry in the summer. Soils may be deep (100 cm or more) consisting of peat or muck with parent material of peat, muck, or alluvium. Many of these ponds have their geologic origin as a more-or-less complete karst collapse feature. Some of them may display this geologic origin in a more explicit manner with definite walls and exposed limestone or dolomite at the surface. Others are more subtle, and exist as more gentle depressions with no exposed surface geology.

The number and locations of all natural ponds within the project area are not documented in District records.

Ponds, Lakes and Waterholes

Constructed ponds serve many biological functions in the uplands. They provide a year-long source of water and are extremely important as a drinking water source for wildlife during drought as well as a permanent home for aquatic species. Temporary ponds provide for a variety of habitats for plants and animals especially amphibians, which can include living, reproductive and rearing habitats.

Water holes (temporary ponds) provide a variety of hydro-periods and provide for native amphibian species. Different structural components are present in the ponds and lakes including brush, logs, and boulders to provide for habitat complexity for all native and desirable aquatic species.

Mirror Lake and Gunner Pool are man-made impoundments within the Blanchard Springs and Gunner Pool Developed recreation areas respectively. These waterbodies are stocked with sport fish by the AR Game and Fish Commission.

Seeps and Springs

Seeps and springs are areas where water flows directly out of the ground. These areas are important for many species on the Forest, as they often supply water on otherwise dry hillsides and glades. They provide habitat for several salamanders with viability concerns.

Few locations have been recorded; others likely exist. To provide for all native species associated with these areas, hydrology and openness should be maintained.

These communities are typically found on side or lower slopes, the bases of bluffs, rock ledges, and terraces of streams and rivers. They are characterized by soils that are semi-permanently to permanently saturated as a result of groundwater seepage, and by the presence of species such as sedges, ferns, and sphagnum. Dominant vegetation may be herbs, shrubs, trees, or some complex of the three. Field delineation of these communities includes sufficient buffers to maintain hydrology. Downed wood in surrounding buffers are important as cover for associated animals.

Canebrakes

Canebrake habitat was once much more prominent on the Ozark-St. Francis National Forest than it is today. Conversion of the bottomlands for agricultural purposes during settlement, an interrupted fire regime that sustained cane, and the subsequent encroachment of trees into open areas have led to the reduction in the amount of canebrake habitat.

This community is characterized by almost monotypic stands of giant or switch cane (*Arundinaria gigantea*), usually with no or low densities of overstory tree canopy. Typically, it is found in bottomlands or stream terraces. Although cane is found commonly as an understory component on many of these types of sites, treatment as a rare community is reserved only for larger patches (generally > 0.25 acres) exhibiting high densities that result in nearly monotypic conditions, or to areas selected for restoration of such conditions.

On the District, the areas with the best potential for canebrake establishment occur in the wide river bottoms along the White River.

Direct, Indirect and Cumulative Effects

<u>Alternative 1</u>
Under Alternative 1, no activities will be conducted that are not currently approved within the project area, so there will be no direct effects. Prescribed burning will still be implemented across much of the project area and will likely benefit glades and cane, but will not be likely to fully restore either community. Non-native invasive plant species would spread unchecked across most of the project area, and cave gates will not be installed to protect the environments within hibernacula from human disturbance.

From a cumulative perspective, any beneficial effects to rare communities resulting from the project will help to increase biodiversity of the District.

Alternatives 2 and 3

Both alternatives will implement similar activities that yield similar results for rare communities and will be discussed together. Glade habitats and cane should benefit from the proposed activities of Alternatives 2 and 3 as both communities respond positively to increased sunlight, restoration of regular fire return intervals and reductions in non-native invasive plants, but these activities are not likely to result in full restoration of either community during the timeframe for this project. Increased species richness resulted in glade habitats where similar treatments were conducted by state government agencies and non-government organizations across the state.

As field examinations are conducted, locations of rare communities will be documented and entered into the Forest's database. Forest Plan standards and AR State Forestry Commission's Best Management Practices are sufficient to protect habitats provided by caves, karst, ponds, sinkholes, lakes, seeps and springs from runoff and sedimentation. Gating may further help to protect the delicate environments of caves from damage caused by human disturbance, and post gating monitoring will help to ensure this action does not alter the microclimates within cave systems.

Vegetation management will likely be limited around Gunner Pool, Mirror Lake and in cliff and talus habitats, so detrimental impacts would not be expected.

From a cumulative perspective, any beneficial effects to rare communities resulting from the project will help to increase biodiversity of the District.

Non-native Invasive Plant Species

Natural and anthropogenic disturbance promote the spread of non-native invasive plant species. Non-native invasive plant species often have a competitive advantage over other vegetation and rapidly invade disturbed areas and other forest openings (Westbrooks 1998). Invasive plants can alter natural ecosystems in several ways, including replacing native species with exotic species, inducing changes in water or fire regimes, causing changes in soil characteristics, adding a new or displacing an existing wildlife food source, and altering erosion and sedimentation processes (Westbrooks 1998). Species like tree of heaven and Paulownia (princess tree) produce allolopathic chemicals that prevent other plant species seeds from germinating and becoming established; mimosa, English ivy, tree of heaven and Paulownia are shade tolerant and can survive and spread without canopy disturbance (Miller at al. 2010a, Miller et al. 2010b).

Native communities and ecological processes can be impacted by establishment of non-native invasive plant infestations (Brooks et al. 2004). Some non-native invasive plant species can dominate entire ecological communities; alter soil stability; affect soil nutrient and chemistry composition; and change fire regimes (Vitousek 1990, Richardons et al. 2000). Non-native invasive plant species also have potential to dramatically change vegetation composition of natural communities and change ecological processes like fire regime and intensity.

The USDA Forest Service National Strategy and Implementation Plan for Invasive Species Management states that a species is considered invasive if:

- It is nonnative to the ecosystem under consideration; and
- Its introduction causes or is likely to cause economic or environmental harm or harm to human health.

Numerous non-native invasive and exotic plants primarily affect forest health by replacing native species and reducing native plant biodiversity. Damage to forest communities occur in varying degrees depending on community type, species composition, location on the landscape, age of the forested community, past disturbance, stress factors, and weather conditions.

Species from the Regional Forester's list that are found in Arkansas or that pose a threat to Arkansas ecosystems are identified in Table 12. Inclusion of a species on the list is not a certification that it is known to occur in Arkansas or on national forest lands, but this list can be used to inform Forest Service personnel about these species as likely threats and heightens the awareness that these species may be present on the Forests. These "weed" species are divided into the following three categories:

- **Category 1 Species**: These are non-native plant species that are known to be invasive and persistent throughout all or most of their range within the Southern Region. They can spread into and persist in native plant communities and displace native plant species; therefore, posing a demonstrable threat to the integrity of the natural plant communities in the Region. .
- **Category 2 Species**: These are non-native plant species that are suspected to be invasive or are known to be invasive in limited areas of the Southern Region. Category 2 Species will typically persist in the environment for long periods once established, and may become invasive under favorable conditions. Plant species in Category 2 pose a significant risk to the integrity of natural plant communities throughout the Region or in parts of the Region.
- **Category 3 Species:** These are non-native plant species that are suspected to be invasive or are known to be invasive in Arkansas but are not currently on the Regional Forester's list. These species are recognized by the Arkansas Heritage Commission as being a current or potential threat to lands in Arkansas.

Table 12. Non-native invasive plant species from the Regional Forester's list that are found in Arkansas or that pose a threat to Arkansas ecosystems

(Species in **bold type** are known to occur on the Sylamore District.)

Scientific Name	Common Name(s)	Habitat	Comments	Species Category
Ailanthus altisimma	**Tree of heaven**	Windthrow gaps, roadsides, open woods	Increasing in Ozarks. Benefits from disturbance.	1
Albizia julibrissin	**Silktree Mimosa**	Roadsides, stream banks, windthrow, old fields	Common. Benefits from disturbance.	1
Alliaria petiolata	Garlic mustard	Mesic woods, floodplains	Tolerates shade. Dispersed by hikers, vehicles, Off Highway Vehicles, & Wildlife.	1
Ampelopsis brevipedunculata	Porcelainberry	Mesic woods, streamside, lake margins	Collected in 2003 from fluctuation zone around Beaver Lake in Benton County.	2
Arthraxon hispidus	Carpgrass	Wet areas in pastures & prairies, roadside ditches, and along streams	Benefits from ground disturbance. Does well on moist soils. Spread by mowing.	2
Bromus spp.	Cheatgrass Bromegrass Chess	Roadsides, glades, rocky open woodlands	Common in the Ozarks. Spread by mowing & ground disturbance. Native species in Arkansas are *B. pubescens* & *B. nottowayanus*. All others are potential invasives.	2
Carduus nutans	Nodding thistle Musk thistle	Roadsides, glades, pastures, old fields	Spreading rapidly in Ozarks. Mowing is a likely vector.	2
Celastrus orbiculatus	Oriental bittersweet	Forest edges, disturbed woods	Common around Fayetteville, AR and likely to spread; probably dispersed by birds.	1
Centaurea beibersteinii (incl. C. maculosa and C. stoebe)	Spotted knapweed Russian knapweed	Roadsides, glades, prairies, pastures, old fields	Now common and spreading in NW Arkansas. Spread by mowing along roads. Has well-documented allelopathic properties.	2

Table 12. Non-native invasive plant species from the Regional Forester's list that are found in Arkansas or that pose a threat to Arkansas ecosystems

(Species in **bold type** are known to occur on the Sylamore District.)

Scientific Name	Common Name(s)	Habitat	Comments	Species Category
Coronilla varia	**Crown vetch**	Roadsides	Found on the Sylamore RD. Out-competes native species.	2
Leucanthemum vulgare (= Chrysanthemum leucanthemum)	**Ox eye daisy**	Roadsides, prairies, pastures, old fields	Across the Ozarks along roads and pastures. Spreads by mowing.	3
Cynodon dactylon	**Bermuda grass**	Occasionally in glades and prairies	Hard to eradicate	3
Dioscorea oppositifolia (=D. batatas)	Air potato	Mesic woods, edges	Benefits from disturbance	1
Dipsacus fullonum	Teasel	Roadsides, old fields	Spreading rapidly along roads in the Ozarks	3
***Elaeagnus spp. (E. umbellata**, E. pungens, E. angustifolia)*	Russian olive Thorny olive **Autumn olive**	Forest edge, along streams	*E. umbellata* and *E. pungens* are naturalized widely in Arkansas. Both were planted for wildlife in the past.	1 &2
Eragrostis curvula	Weeping lovegrass	Roadsides, glades, rocky open areas	Planted along roadsides. Does well in thin soils. Invades glades. Spread by mowing.	2
Euonymus fortunei	Wintercreeper Euonymus	Mesic woods	Problem on many NW Arkansas natural areas. Covers ground (evergreen). Flowers & fruits when it climbs trees. Probably dispersed by birds.	1
Festuca arundinacea (a.k.a Lolium arundinaceum)	**Tall fescue**	Roadsides, prairies, pastures, old fields	Invades prairies and is difficult to eradicate. Spreads by mowing & water flow. Declines with repeated fire.	3

Table 12. Non-native invasive plant species from the Regional Forester's list that are found in Arkansas or that pose a threat to Arkansas ecosystems

(Species in **bold type** are known to occur on the Sylamore District.)

Scientific Name	Common Name(s)	Habitat	Comments	Species Category
Glechoma hederacea	**Ground ivy**	Stream terraces	Dominant on periodically flooded, shaded terraces of Buffalo National River in Newton Co. Also found on Sylamore RD.	3
Hedera helix	**English ivy**	Woods	Probably planted. Not hard to eradicate with herbicide.	2
Holcus lanatus	Velvetgrass	Prairies, old fields, pastures	Very difficult to eradicate. Spread by mowing & water flow.	3
Lespedeza bicolor	**Bicolor lespedeza Shrubby lespedeza**	Roadsides	Persists & spreads. Out-competes native vegetation.	3
Lespedeza cuneata	**Sericea lespedeza**	Roadsides, glades, prairies, pastures	Invades open habitat. Very difficult to eradicate.	1
Ligustrum sinens (& L. vulgare)	**Privet**	Mesic woods, prairies, margins of glades, stream corridors	Major problem in Arkansas. Spread by birds. Can be controlled by cutting & treating stumps with herbicide	1
Lonicera japonica	**Japanese honeysuckle**	All habitats	Major problem in Arkansas. Outcompetes native vegetation in variety of habitats. Repeated fire will control.	1
Lonicera maackii	Bush honeysuckle Shrub honeysuckle	Forest edge, mesic woods, dry woods, glades	Very common around Fayetteville & Springdale, AR and spreading. Seems to like calcareous soils. Excludes all herbaceous plants when it forms dense thickets.	1
Lythrum salicaria	Purple loosestrife	Wetlands	Known from Ozarks. Needs to be watched for.	1

Table 12. Non-native invasive plant species from the Regional Forester's list that are found in Arkansas or that pose a threat to Arkansas ecosystems

(Species in **bold type** are known to occur on the Sylamore District.)

Scientific Name	Common Name(s)	Habitat	Comments	Species Category
Melia azedarach	Chinaberry	Forest edge, pastures, old fields	Scattered in Ozarks.	2
Melilotus alba (& M. officinalis)	**White sweetclover**	Roadsides, pastures, glades, prairies, open areas, woodlands	Major problem in some glade areas. Appears to like calcareous soils.	3
Microstegium vimineum	**Japanese stiltgrass;**	Mesic woods, stream corridors	Spreading extremely rapidly. Probably in every Ozark county and major watershed. Capable of displacing all native herbaceous vegetation on stream terraces. Spread by water flow & mowing.	1
Paulownia tomentosa	**Princess tree Empress tree**	Forest edge, windthrow gaps, pastures, old fields	Increasing in the Arkansas Ozarks.	3
Perilla frutescens	**Beefsteak plant**	Open woods, roadsides, floodplains of streams, pastures, etc.	Common on Sylamore RD. Benefits from road construction, soil disturbance.	3
Pueraria montana	**Kudzu**	Forest edges, roadsides, pastures, & adjacent areas.	Increasing all the time from old plantings, etc. Found in Compartment 54 on the Sylamore RD.	1
Pyrus calleryana	Callery pear	Forest edges, roadsides, clearings, open woods, pastures, windthrow gaps	Rootstock for many grafted ornamental pear trees (including "Bradford"). Suckers rapidly produce fertile seeds that are dispersed by birds. Very aggressive.	3
Rosa multiflora	**Multiflora rose**	Forest edges, roadsides, clearings, pastures, old fields, prairies, windthrow gaps, stream corridors	Spread by birds.	1

Table 12. Non-native invasive plant species from the Regional Forester's list that are found in Arkansas or that pose a threat to Arkansas ecosystems

(Species in **bold type** are known to occur on the Sylamore District.)

Scientific Name	Common Name(s)	Habitat	Comments	Species Category
Sorghum halepense	**Johnson grass**	Forest edge, roadsides, pastures, old fields, prairies, margins of glades	Benefits from soil disturbance. Thick infestations in some of the Sylamore District's range allotments.	1
Vinca major (& V. minor)	**Periwinkle**	Forest edges, roadsides, old fields, etc.	Spreads from old plantings, home sites, etc. Outcompetes all other herbaceous plants.	3
Wisteria sinense (& possibly W. floribunda)	**Chinese wisteria**	Forest edge, old fields, pastures, etc.	Spreads from old plantings, home sites, etc. Can choke out trees, damage buildings, etc.	2

A general non-native invasive plant survey of project area wildlife openings and road sides was conducted in 2012. The infestations of non-native invasive plants in these locations totaled approximately 673 acres and represent a minimum infestation area. Other potentially infested areas include riparian corridors, trails, recreational and administrative sites, parking areas, and wild-land urban interface.

An estimate of potentially infested areas is shown in Table 13. The estimates were derived from the Forest geographic information system database by applying the buffer widths shown below to the following:

- wild-land urban interface(½ mile buffer);
- system roads (a 25 foot buffer from the road's edge on both sides);
- authorized trails (a 25 foot buffer from the trail's edge on both sides);
- riparian areas (a 100 foot buffer on each side); and
- all acres within developed recreation areas, administrative sites and managed wildlife openings.

Table 13. Estimate of Acres with Non-native Invasive Plant Infestations within the Indiana Bat Habitat Restoration Project Area

Area	Acres	Estimated % of the Area Infested	Estimated Acres Infested
Wild-land Urban Interface	22,141	10%	2,214
System Roads	3,635	10%	364
Trails	676	1%	7
Wildlife Openings	413	78%	322
Recreation and Other Administrative Sites	650	10%	65
Riparian Areas	367	5%	18
Total	27,882		2,990

Direct and Indirect Effects

Alternative 1
Under the no action alternative, no changes to the existing environment would occur beyond those attributed to previously approved actions and natural processes and disturbances. Within the Indiana Bat Habitat Restoration Project area ice storm damage and previously approved actions have created conditions likely to result in the establishment and spread of non-native invasive plant species. At present, non-native invasive plant species control methods are only approved within the *Rorie Project* area (4,858 acres) and the *Kudzu Eradication Project* area (20 acres). Other previously approved actions may simultaneously remove some individual non-native invasive plants, but will not effectively control established infestations. Across most of the project area, non-native plants will not be controlled and will therefore spread unchecked. Seed and propagule dispersal to new locations would occur over time creating additional infestations at non-infested locations.

Alternatives 2 and 3:
Under alternatives 2 and 3, a series of activities would be used to improve and maintain roosting and foraging habitat for the endangered Indiana bat which will create gaps in the canopy and result in temporary soil disturbances. These effects and those resulting from previously implemented activities in the project area are likely to promote the establishment of new and the spread of existing non-native invasive plant species. However, the implementation of a non-native invasive plant control strategy will reduce the potential for this occurrence. Control of non-native plant infestations is consistent with Forest Plan direction and direction outlined in Forest Service Manual 2080.

Treatment of non-native invasive plants would reduce the potential of native species being displaced. When actions are prescribed, survey for non-native invasive plant species will be conducted. Prior to or concurrently with implementation of those actions, non-native invasive plant infestations will be treated; cleaning equipment and clothing before going from an area

with non-native invasive plant infestations to an area where none are known to occur will help reduce potential for their inadvertent spread. Under Alternative 2, non-native invasive plants present in timber stand or wildlife stand treatment units would likely be treated with herbicide during those operations and may be killed. Under Alternative 3, they would be cut with handtools or chainsaws those operations. Because only the above-ground portions would be removed, they would resprout.

Non-native invasive plants within streamside management zones or adjacent to bodies of water would be treated with one of the herbicide formulations labeled for aquatic use as required by Forest Plan standard FW32. No surfactant would be used, so the effectiveness of the treatment may be less than that of treatments outside these buffer zones.

Non-target (native) plants within large infestations such as Sercicia lespedeza populations found along roadsides or in wildlife openings will be killed during foliar herbicide applications. This is an unavoidable consequence, and the effect is temporary. The beneficial aspect of treating such infestations outweighs the negative effect of losing a few individual non-target plants within them. Not treating such infestations to avoid affecting individual non-target plants would lead to displacement of native plant communities. The seed-bank and the surrounding untreated areas contain seed of native species which will not be affected by herbicide applications. As the non-native species are removed, native vegetation will be able to reclaim the treated areas.

These alternatives will only serve to keep non-native invasive plant infestations in check; they will not be eradicated during the timeframe for this project. The herbicides proposed for use with this project were selected in part for their limited persistence in the environment. Other chemical treatments are known to be more effective. If successive treatments with all of the proposed herbicides outside streamside management zones or with glyphosate or triclopyr amine labeled for aquatic use within streamside management zones are not effective at controlling some non-native invasive plant infestations, a new National Environmental Policy Act analysis to examine the effects of using a different herbicide or treatment regimen would be initiated.

Cumulative Effects

<u>Alternative 1</u>
The ice storm of 2009 damaged several thousand acres of trees across the District. The ice storm of 2009 created conditions that promote the spread of non-native invasive plant infestations. Currently approved projects will add to the disturbance regime. As most of these projects do not include non-native invasive plant treatments the spread of infestations would go unchecked increasing in size and number and displacing native plant communities. Eventual dominance of non-native invasive plants across the landscape could occur.

<u>Alternatives 2 and 3</u>
Because a non-native invasive plant control strategy would be implemented with these alternatives, the potential for the spread of these weeds into disturbed areas following management actions will be reduced; this strategy will also help offset the spread of infestations

from other previously implemented actions within the project area and help limit the potential for their proliferation across the landscape.

Threatened, Endangered and Regional Forester's Sensitive Listed Species

A Biological Evaluation and an assessment of effects on Regional Forester's sensitive listed species were completed for this project and are provided in their entirety in Appendix C of this document. Determinations of effect findings for federally listed threatened and endangered species and for Regional Forester's (Region 8) sensitive listed species are summarized in Tables 14 and 15 below.

Table 14: Determination of Effect for Federally Listed Threatened or Endangered Species that are Known to Occur or with Potential to Occur on the Sylamore District

Species	Listed As	Determination of Effect		
		Alternative 1	Alternative 2	Alternative 3
Gray bat	Endangered	Likely to adversely affect	No effect	No effect
Indiana bat	Endangered	Likely to adversely affect	Not likely to adversely affect	Not likely to adversely affect
Ozark big-earred bat	Endangered	Likely to adversely affect	No effect	No effect
Hell Creek Cave crayfish	Endangered	No effect	No effect	No effect
Pink Mucket	Endangered	No effect	No effect	No effect
Missouri Bladderpod	Threatened	No effect	No effect	No effect

Table 15: Determinations of Impact for Regional Forester's (Region 8) Sensitive Listed Species that are Known to Occur or with Potential to Occur on the Sylamore Ranger District

Species	Determination of Effect		
	Alternative 1	Alternative 2	Alternative 3
Eastern small-footed bat	may impact individuals but [is] not likely to cause a trend to federal listing or a loss of viability	may impact individuals but [is] not likely to cause a trend to federal listing or a loss of viability	may impact individuals but [is] not likely to cause a trend to federal listing or a loss of viability
Bald eagle	No impact	No impact	No impact
Ozark shiner	No impact	No impact	No impact
Southern cavefish	No impact	No impact	No impact
Nearctic paduneillan caddisfly	No impact	Beneficial effects and may impact individuals but [is] not likely to cause a trend to	Beneficial effects and may impact individuals but [is] not likely to cause a trend to

Table 15: Determinations of Impact for Regional Forester's (Region 8) Sensitive Listed Species that are Known to Occur or with Potential to Occur on the Sylamore Ranger District

Species	Determination of Effect		
	Alternative 1	Alternative 2	Alternative 3
		federal listing or a loss of viability	federal listing or a loss of viability
Lirceus bicuspidatus, an isopod	No impact	beneficial effects and may impact individuals but [is] not likely to cause a trend to federal listing or a loss of viability	Beneficial effects and may impact individuals but [is] not likely to cause a trend to federal listing or a loss of viability
Ozark chinquapin	No impact	may impact individuals but [is] not likely to cause a trend to federal listing or a loss of viability	may impact individuals but [is] not likely to cause a trend to federal listing or a loss of viability
Southern lady's slipper	No impact	No impact	No impact
Newton's larkspur	No impact	No impact	No impact
Glade larkspur	No impact	beneficial effects and may impact individuals but [is] not likely to cause a trend to federal listing or a loss of viability	beneficial effects and may impact individuals but [is] not likely to cause a trend to federal listing or a loss of viability
Open-ground draba	No impact	beneficial effects and may impact individuals but [is] not likely to cause a trend to federal listing or a loss of viability	beneficial effects and may impact individuals but [is] not likely to cause a trend to federal listing or a loss of viability
Butternut	No impact	may impact individuals, but [is] not likely to cause a trend to federal listing or a loss of viability	may impact individuals, but [is] not likely to cause a trend to federal listing or a loss of viability
Ovate leaf catchfly	No impact	may impact individuals, but [is] not likely to	may impact individuals, but [is] not likely to

Table 15: Determinations of Impact for Regional Forester's (Region 8) Sensitive Listed Species that are Known to Occur or with Potential to Occur on the Sylamore Ranger District

Species	Determination of Effect		
	Alternative 1	Alternative 2	Alternative 3
		cause a trend to federal listing or a loss of viability	cause a trend to federal listing or a loss of viability
Royal catchfly	No impact	may impact individuals, but [is] not likely to cause a trend to federal listing or a loss of viability	may impact individuals, but [is] not likely to cause a trend to federal listing or a loss of viability
Ozark spiderwort	No impact	may impact individuals, but [is] not likely to cause a trend to federal listing or a loss of viability	may impact individuals, but [is] not likely to cause a trend to federal listing or a loss of viability
Ozark least trillium	No impact	may impact individuals, but [is] not likely to cause a trend to federal listing or a loss of viability	may impact individuals, but [is] not likely to cause a trend to federal listing or a loss of viability
Ozark cornsalad	No impact	may impact individuals, but [is] not likely to cause a trend to federal listing or a loss of viability	may impact individuals, but [is] not likely to cause a trend to federal listing or a loss of viability

Other Terrestrial and Aquatic Species

Management Indicator Species

The National Forest Management Act regulations require the selection of management indicator species during the development of forest plans (36 CFR 219.19 [a]). Management indicator species are selected "because their population changes are believed to indicate the effects of management activities" (36 CFR 219[a][2]).

Management Indicator Species are analyzed based on the type of habitat they use, the amount of habitat currently available within the project area and the changes in available habitat due to the no action and the action alternatives.

All management indicator species selected for the Ozark-St. Francis National Forests in the Forest Plan were considered for this analysis. Three species, the Rufous-crowned sparrow, Yellow-breasted chat, and Largemouth bass were eliminated from further consideration. The Rufous-crowned sparrow will not be addressed because it was chosen for management of Mt. Magazine Ranger District, Yellow-breasted chat will not be addressed because it was chosen for management of the St. Francis National Forest, and Largemouth bass will not addressed because it is dependent on large pond and lake habitat and is not managed on the Sylamore Ranger District.

Management indicator species considered are: Northern bobwhite, Whitetail deer, Black bear, Wild turkey, Prairie warbler, Brown-headed nuthatch, Northern parula, Cerulean warbler, Ovenbird, Red-headed woodpecker, Pileated woodpecker, Scarlet tanager, Acadian flycatcher, and Smallmouth bass. The reasons each of these species was chosen is outlined in Table 3-63 of the Final Environmental Impact Statement for the Ozark-St. Francis National Forests Land and Resource Management Plan (page 3-147) with additional discussion for each management indicator species provided on pages 3-145 through 3-162 of the Final Environmental Impact Statement.

Because prescriptions for management will not be prepared until field examinations are completed, these differences cannot be calculated in absolute terms. It will be assumed the maximum annual extent identified under each action alternative will be implemented.

The *2009 Ice Storm Hazardous Fuels Reduction Project* overlaps the majority of the proposed project area. Approximately 49,000 National Forest Service acres within the project area are presently approved to receive prescribed burning treatments at a rate of between 12,000 and 15,000 acres per year; it also provides for salvage of damaged timber when accessible, mechanical treatments and removal of ladder fuels. It cannot be predicted when or where secondary impacts from ice damage will manifest.

Direct, Indirect and Cumulative Effects

<u>Alternative 1</u>
Under this alternative, no new actions will be implemented under the *Indiana Bat Habitat Restoration Project* so there will be no direct or cumulative effects. Indirect affects will result as current conditions and trends continue and existing management within the project area continues.

Under the no action alternative, current conditions and trends will continue. Where the *2009 Ice Storm Hazardous Fuels Reduction Project* and the *Indiana bat Habitat Restoration Project* areas overlap, burning and mechanical treatments would still be implemented reducing the amount of brushy understory and stimulating the growth of browse and herbaceous plants. Non-native invasive plants will spread unchecked throughout the majority of the project area to displace native plant communities.

No stands would be regenerated except through natural processes. Because activities to promote the survival and recruitment of oak-hickory regeneration into the overstory will not be implemented, a shift in species composition dominated by shade tolerant species will occur over the long term; these species do not provide the same benefit for wildlife as oak-hickory and pine forest types. Forested acres will continue to age. Most overcrowded stands will not be mechanically thinned under the *2009 Ice Storm Hazardous Fuels Reduction Project*. The potential for hard mast (acorn and hickory nut) production in the area would not be improved.

The no action alternative will not affect the suitability of the area for Northern parula, red-headed woodpecker, Acadian flycatcher, prairie warbler, brown-headed nuthatch, or smallmouth bass. None of the project area is currently considered suitable for red-headed woodpeckers or brown-headed nuthatches because of its closed canopy conditions. Prairie warblers require large regeneration sites or open woodlands. Potential habitat for Northern parula, Acadian flycatchers, and smallmouth bass will not be affected by the no action alternative.

Habitat will decline in its suitability for deer, black bear and wild turkey over time; the limited amount of suitable quail habitat would be lost within ten years and would not be replaced. Wildlife openings outside the *2009 Ice Storm Hazardous Fuels Reduction Project* area will not be burned; the high-quality year-round forage for deer and herbaceous food, brood rearing and bugging habitat for turkey will be lost within ten years in those openings. Low levels of browse (required by deer and black bear) and herbaceous understory (utilized by turkey) will not change. Stands where mast production is already beginning to decline because of age (hardwood stands greater than 70 years old), or over-crowding will continue to age and produce progressively lower levels of mast needed by all three species. Brushy understory conditions will continue to impede wild turkey movement. There will be no regeneration areas created to provide cover and alternative food sources for black bear.

The number of suitable acres for ovenbird, scarlet tanager, and pileated woodpecker would increase under the no action alternative due to natural aging of forested stands. Suitable habitat acres would increase only minimally because most of the hardwood acres in the project area already meet the minimum maturity level required by these species (40 years old for ovenbird and scarlet tanager; 70 years for pileated woodpecker). Within 40 years all hardwood acres would be 40 years or older and would be considered suitable habitat for ovenbird and scarlet tanager. For pileated woodpeckers, the entire area would become suitable habitat under the no action alternative as young forested acres progress toward mature conditions.

Habitat suitability for the cerulean warbler would not change greatly under the no action alternative; most hardwood acres with suitable site indices (70 or greater) are already greater than 40 years old.

The no action alternative will not alter suitable habitat for smallmouth bass.

<u>Alternatives 2 and 3</u>
Commercial and non-commercial thinning treatments and use of prescribed fire will result in increases in structural and age class diversities, mast production and improved forest health over

the current condition. The spread of non-native invasive plant species will be controlled across a greater percentage of the project area under these alternatives than under the no action alternative, and prescribed fire will be applied across more the project area under the action alternatives than under the no action alternative.

Under the action alternatives, quail will benefit from cutting and prescribed burning activities. These actions will open the understory and increase the amount of grasses and forbs that can grow there.

The proposed action would enhance deer and turkey habitat throughout the project area. Repeated prescribed burning of the landscape and thinning will increase the amount of forage available for both species by increasing the diversity and abundance of grass and forb species growing in the understory and improving the stands' ability to produce hard mast of mixed oak and oak hickory stands. For turkey, this activity will also open up the area improving movement and increasing the amount of available bugging areas. Regenerating stands will be created, increasing the level of browse available to white-tailed deer. These optimal foraging conditions will remain for decades following treatment.

Suitability of the project area for black bear will improve. Early seral stage forest will be created, stands will be thinned, and existing open habitats will be enhanced or maintained. An initial increase in woody regrowth in the season following the first landscape scale prescribed burn will be seen; subsequent burns will stimulate a large increase in the amount of shrubs and herbaceous understory (succulent plants) in all stands and provide escape cover for 3-5 years following action. In addition, hard mast production will be improved in the mixed oak/hickory stands that receive thinning treatments. Improved conditions will remain for decades following treatment.

Immature pine stands (immature pole and sawtimber size) would be thinned and subjected to repeated prescribed burns. These management actions will open up the overstory and encourage the growth of grasses in the understory. The residual stems in these areas may provide suitable habitat for brown-headed nuthatches, although they seem to prefer mature pine timber. Brown-headed nuthatches have not been recorded at the bird survey points on the Sylamore District, calling into question whether or not created habitat would be utilized by this species.

Suitable habitat for prairie warblers would be created during the regeneration harvests. These stands would remain suitable for no more than ten years before reverting to a state too forested to be optimal.

Under the proposed action alternative, the amount of suitable cerulean warbler habitat in the area will be reduced slightly by shelterwood harvests and prescribed burning. Cerulean warblers prefer complex vertical habitat and canopy gaps.

Regeneration harvests would render some areas unsuitable for 40 years for ovenbirds and scarlet tanagers and 70 years following regeneration for pileated woodpeckers. These acres would be replaced by natural growth in the remaining stands at the same rate as under the no action

alternative. For ovenbird and scarlet tanager as younger stands age, they will become suitable over the next 10 to 40 years and for pileated woodpecker, additional acres would become suitable over the next 10 to 70 years. Thinning hardwood stands within the project area may reduce their suitability for these species. Burning conditions will be selected to generate a burn that is generally not hot enough to consume standing fuels or damage large timber. Prescribed burning may remove some snags and logs on the ground that could be used by pileated woodpeckers, but may also create others.

The project area will gain suitable habitat for the red-headed woodpecker as thinned and burned stands reach maturity. These stands will reach suitable age (maturity) at approximately 60 years old for hardwoods and 40 years old for pines. The use of prescribed fire could result in some existing snags being consumed, but new snags would likely also be created.

The action alternatives will not appreciably affect the suitability of the area for Northern parulas, Acadian flycatchers, or smallmouth bass. Prescribed burning will take place throughout the project area. During prescribed burning, fires typically go out gradually as they reach the moister areas along streamsides; a portion of the leaf litter will remain unconsumed and there will be a filter zone to prevent ash from entering the stream. Road work to facilitate removal of timber would reduce the potential for sediment production from haul roads. Within the riparian corridor, timber harvest actions would likely be limited, and would not be expected to increase in the temperature of perennial streams in the project area. There will not be any change in the amount of potentially suitable habitat for the smallmouth bass.

The project planning record and the Final Environmental Impact Statement prepared during development of the Forest Plan include additional information regarding effects on habitat.

Insect Prey of Indiana Bats

Indiana bats feed exclusively on terrestrial and aquatic flying insects. The most common prey items taken by Indiana bats are moths, beetles and mosquitoes. Prey selection depends largely on availability in the foraging habitat; diets are likely to vary seasonally. Other insects that may be consumed include bees, wasps, ants, leafhoppers, lacewings, and mayflies.

Specific data addressing changes in volant insect faunas due to changes in vegetation structure and fire regimes are not available for the Ozark region. No baseline data regarding current population size of volant insect faunas is available for the Sylamore District.

At present, grasses, flowering plants and other forbs used during various phases of insect life cycles are lacking in the understory and degraded glade habitats. Sericia lespedeza infestations are evident along most of the project area roads crowding out native species.

Direct, Indirect and Cumulative Effects,

<u>Alternative 1</u>

As no activities associated with this project would be conducted, there will be no immediate change in the understory or within glade habitats. Current conditions and trends will continue. Burning and other vegetation management actions previously approved within the project area boundaries will be implemented until those projects are complete. These actions will stimulate growth of grasses and forbs where they occur, but no actions to maintain those conditions will follow and they will return to pre-treatment conditions as woody encroachment reclaims the understory.

Alternatives 2 and 3

Vegetation structure and fire regimes are known to influence arthropod faunas, especially lepidopterans. In the forested southeastern U. S., studies have shown that sites with less canopy closure, reduced woody midstory vegetation, increased herbaceous vegetation, and a frequent fire return interval support an increased abundance of butterflies (Rudolph & Ely 2000, Thill et al. 2004). The increased abundance of butterflies is correlated with an increased abundance of nectar resources, primarily due to increased flowering in the herbaceous component (Rudolph et al. 2006). The positive effect of fire on the flowering of herbaceous plants is relatively short lived. By the 3rd growing season post-burn, flowering of herbaceous species is declining markedly, as is the abundance of butterflies. Broadly similar results have been reported in forested habitats in other regions.

For several years USDA Forest Service Southern Research Station scientists have conducted surveys of volant insects in a landscape scale restoration project on the Ouachita National Forest (Bukenhofer and Hedrick 1997). The restoration was a highly successful attempt to restore historical vegetation structure, in part to provide habitat for the endangered Red-cockaded Woodpecker (*Picoides borealis*). Restoration management for that project was similar to the proposed project, consisting of overstory thinning, midstory reduction, and prescribed burning every three years. This management scenario resulted in a massive increase in herbaceous vegetation compared to the untreated sites where vegetation structure had been highly altered due to decades of fire suppression and relatively ineffective prescribed fire (Thill et al. 2004).

The responses of nocturnal flying insects in the Ouachita Mountains restoration demonstrate that overall abundances of lepidopterans, coleopterans, dipterans, and tricopterans vary less than three-fold between restored stands and unrestored control stands. In general, factors such as weather, season, and phenology of individual species have a greater influence on insect abundances. This suggests that restoration of a fire-maintained pine ecosystem in the Ouachita Mountains does not have a major impact on the abundance of prey for insectivorous bats. Assuming that the response of insects to a structurally similar restoration project on the Ozark National Forest follows these patterns, insect abundances following restoration may remain broadly similar to abundances prior to restoration. The major difference may be somewhat reduced moth abundances early (April and June) in the season, and moderately increased abundances later (August and September/October) in the season. Season differences in insect abundance are generally greater than differences due to vegetation structure and other factors. Differences in vegetation structure allowing bats improved access to flying insects following restoration may be more important than the absolute abundances of insects.

The primary difference between the restoration project on the Ouachita National Forest and the proposed project on the Ozark National Forest involves the dominant species of canopy trees. The Ouachita Mountains sites were dominated by shortleaf pine (*Pinus echinata*) with a significant hardwood component, primarily oaks and hickories. In contrast, the Ozark Mountains sites are dominated by hardwoods, primarily oaks and hickories, with a minor shortleaf pine component. However, the change in woody vegetation structure and the increase in herbaceous vegetation is anticipated to be broadly similar and will presumably result in an increase in the abundance and diversity of the herbaceous flora.

Neotropical Migratory Birds

Range-wide, many early-successional neotropical migratory bird species have declined due to forest maturation, fire suppression, reduction of grazing, and low levels of active forest management on federal lands. Closed canopy forest is presently over-represented across the region. About 20 percent of bird species known to breed in the region—including those of concern—have declined significantly in the last 37 years. Fifteen percent of the Neotropical Migratory Birds have declined significantly (Sauer et al. 2004). Acreage needs of early-successional species however, must be balanced with the needs of mature forest species also in need of conservation attention.

Birds with significant declining trends were loggerhead shrike, common nighthawk, bell's vireo, prairie warbler, lark sparrow, red-headed woodpecker, northern bobwhite, gray catbird, northern flicker, brown thrasher, eastern towhee, field sparrow, orchard oriole, house sparrow, green heron, belted kingfisher, brown-headed cowbird, great crested flycatcher, and blue jay. Habitat needs of these significantly declining birds show that eight are scrub breeding birds; ten breed in savanna/woodland conditions; five were grassland species, and two use stream or lake habitats.

The Southern National Forest's Migratory and Resident Landbird Conservation Strategy or R8 Bird (Gaines and Morris 1996) identifies priority species and provides a framework for monitoring populations. In the Central Hardwoods Conservation Area, an analysis of Breeding Bird Survey data from 2000–2010 shows 7 species of Neotropical Migrant birds with significant downward trends. Species with significant downward trends include Yellow-Billed Cuckoo, Chimney Swift, Dicksissel, Gray Catbird, Prairie Warbler, Common Yellowthroat and Indigo Bunting. There are 13 species showing significant upward trends including Blue Grosebeak, Acadian Flycatcher, Scarlet Tanager, Chipping Sparrow, Yellow-throated Vireo, Ruby-throated Hummingbird, Louisiana Waterthrush, Ovenbird, Yellow-throated Warbler, House Wren, Northern Parula, Scissot-tailed Flycatcher and Cliff Swallow.

There are 26 R8 Bird monitoring points in the project area. These points have been monitored annually since 1997. These points are located in a variety of communities types including Glades, Pine types, Dry Open Hardwoods, Closed Hardwoods, Dry-mesic Hardwoods and Riparian Forests. Species that use habitat provided on the Sylamore District include species of concern. Higher elevations of the project area were affected by the ice storm of 2009. An ocular evaluation of data from bird plots in the project area could not verify any population changes from these events.

Table 16. Data from Bird Point Plots within the Indiana Bat Habitat Restoration Project Area from 1996 through 2011.

Bird	Number		Bird	Number
Red-Eyed Vireo	537		Turkey Vulture	30
Indigo Bunting	259		Eastern Phoebe	29
Carolina Chickadee	226		Chimney Swift	26
Pine Warbler	226		Hairy Woodpecker	22
American Crow	217		Great Crested Flycatcher	19
Blue-Gray Gnatcatcher	202		Mourning Dove	17
Acadian Flycatcher	176		Prairie Warbler	16
Eastern Tufted Titmouse	157		Cerulean Warbler	15
Ovenbird	154		Purple Martin	15
Scarlet Tanager	126		Wood Thrush	15
Northern Parula	124		Yellow-Bellied Sapsucker	13
Hooded Warbler	111		Red-Shouldered Hawk	12
Carolina Wren	109		Yellow Warbler	11
Black-And-White Warbler	97		Yellow-Throated Vireo	11
White-Breasted Nuthatch	97		Ruby-Throated Hummingbird	10
Summer Tanager	92		Brown-Headed Cowbird	8
Eastern Wood-Pewee	78		Yellow-Throated Warbler	8
Downy Woodpecker	75		American Goldfinch	6
Yellow-Billed Cuckoo	74		Belted Kingfisher	5
Pileated Woodpecker	68		Barred Owl	4
White-Eyed Vireo	68		Common Yellowthroat	3
Yellow-Breasted Chat	59		Broad-Winged Hawk	2
Northern Cardinal	46		Wild Turkey	2
Worm-Eating Warbler	45		Blue-Winged Warbler	1
Blue Jay	36		Eastern Towhee	1
Louisiana Waterthrush	35		Olive-Sided Flycatcher	1
Red-Bellied Woodpecker	32		Red-Tailed Hawk	1
Kentucky Warbler	31			

Direct, Indirect and Cumulative Effects

Alternative 1

There will be no immediate change in habitat conditions under this alternative. Indirectly, blocks of mature and over-mature forest-especially those portions exhibiting symptoms of oak decline or with ice damage will continue to decline over time. The area's susceptibility to widespread secondary impacts from ice damage will increase. There will be an eventual shift from

dominance of hardwood from shade-intolerant types (that have dominated the landscape for several thousand years) to shade-tolerant species, especially on the more productive sites. Drier sites would probably remain oak dominated. The area's ability to sustain viable populations of some species is likely to decline.

Alternatives 2 and 3

The Indiana Bat Habitat Restoration Project is consistent with the *Central Hardwoods Joint Venture Strategic Plan (*http://www.chjv.org/CHJV_Strategic_Plan.html). Basal area across much of the project area will be reduced to levels closer to those that existed before fire suppression policies of the 20th century were implemented than the current levels. Gaps in the canopy and more open under and mid story conditions will result. Implementation of the action alternatives would help promote oak regeneration underneath current stands and so that as the older stands die or are harvested through a regeneration cut, recruitment of these species to the overstory is more likely to occur.

Benefits will be realized for many priority grass-shrub and woodland birds such as Prairie Warbler, Blue winged Warbler, Yellow-breasted Chat, Ruffous-sided Towhee, Field Sparrow, Great Crested Flycatcher Eastern Wood Pewee, Red-tailed Hawk. Actions implemented in glade areas would benefit a variety of birds that presently are restricted due to overgrown habitat conditions. Birds benefiting from this include northern bobwhite and painted buntings as well as more common species such as field sparrows. The cedar waxwing could be affected negatively by opening glade habitat although it currently is not listed as a species of conservation concern. In hardwood stands, reductions in density will also benefit several species of concern such as northern bobwhite, red-headed woodpecker, Bewick's wren, Bachman's sparrow, prairie warbler and, to a lesser extent, American kestrel, painted bunting, and orchard oriole. More common birds such as northern flicker, red-tailed hawk, and eastern bluebird will also benefit. In pine-bluestem communities, brown-headed nuthatch, Bachman's sparrow, prairie warbler, redheaded woodpecker, and northern bobwhite could benefit. More common species benefiting for this community include pine warbler and Carolina chickadee.

The action alternatives are not likely to restore much canebrake habitat though conditions that support the growth of cane will be improved. No significant change in habitat for Swainson's warbler or other birds that require canebrake habitat is likely.

Detrimental effects from the planned level of restoration will affect some species of concern. Thinning will reduce habitat suitability for birds that prefer closed canopy forest such as Red-eyed Vireo, ovenbird, and scarlet tanager. Historic records show this condition is currently over-represented across the region, the impacts are, therefore, not expected to be significant.

The improvement from this project area would make a significant contribution to birds needing this type of habitat such as Prairie Warbler, Field Sparrow, Blue-winged Warbler, Brown-headed Nuthatch and Northern Bobwhite as reported at http://www.chjv.org/CHJV_savanna_woodland_P.html.

Aquatic Habitats and Communities

Surveys of project area streams measuring the percentage of pool and riffle habitat, dominant substrate types, percent fines in the substrate, and amounts of Large Woody Debris were conducted between 2000 and 2007. Other surveys to determine fish species composition were conducted between 2006 and 2011. Crayfish have also been surveyed in the watersheds containing the project area, and the Barkshed Recreational Area is also a known site for the Forest (Moulton and Stewart 1996).

Results indicate that habitats provided by the surveyed streams are generally good and able to support the aquatic communities that depend upon them. Overall, however, surveyed streams lacked a large woody debris component. Additional information regarding specific survey findings is provided in the project planning record.

Since those surveys were completed, damage caused by the 2009 ice storm added large amounts of woody debris to the forest floor and in riparian areas. It is plausible some of this material could have been recruited into project area streams. Until additional surveys are completed, the current levels of large woody debris in project area streams will be unknown.

Direct, Indirect and Cumulative Effects

Alternative 1

Alternative 1 will not implement any actions that are not already approved, so no direct or cumulative effects would be expected. Indirectly, because growing conditions will not be improved, fewer trees would be expected to reach sizes that would meet Large Woody Debris requirements. The density of the Forest would also increase transpiration, so less of the annual rainfall would flow into stream channels which mean lower base flows. Non-native invasive plant species will spread unchecked across the majority of the project area, including within riparian habitats; effects to riparian species composition and ultimately riparian functions are likely over the long term. No cave gates would be installed at the entrances of Indiana bat hibernacula; therefore the potential for damage to aquatic communities within the cave systems from human disturbance will not be reduced.

In looking at activities on private and past and future activities on Forest Service lands there would be no cumulative effects from the no action alternative because previously approved actions will be implemented in compliance with Forest Plan standards and other laws and regulations in place to protect water quality.

Alternatives 2 and 3

Project design and requirements to comply with state of Arkansas Best Management Practices and Forest Plan standards will protect aquatic habitats from detrimental effects. As discussed in the ‘Soil’ and ‘Water Quality’ sections of this document, detrimental increases in sediment or nutrient loading in project area streams are not expected, and herbicide applications as proposed are not anticipated to affect water quality. Thinning activities--especially within riparian areas, will help to allow the remaining trees to grow faster and bigger which will eventually provide for

trees that are greater than 19 inches in diameter at breast height to fall and migrate into the stream channel. A decrease in the density of trees would also decrease transpiration rates which would increase the amount of rainfall that can move into the stream channels, albeit slight. Treatment of non-native invasive plants will help to prevent displacement of native riparian plants and protect riparian function.

In looking at activities on private and past and future activities on Forest Service lands, no cumulative effects to aquatic habitats and communities are expected because previously approved actions will be implemented in compliance with Forest Plan standards and other laws and regulations in place to protect water quality.

SOCIAL ENVIRONMENTS

Human Health and Safety

The analysis area for effects to human safety will be the areas in which activities are proposed and the smoke sensitive targets identified for this project.

There are inherent (though not always overt) potential risks to human safety on National Forest System lands ranging from insect bites and falling limbs to the potential for wildfire. Ice storm damage created numerous snags and dead limbs overhead; these hazards will increase as injured trees succumb to injury and additional environmental stresses.

Direct, Indirect and Cumulative Effects

Alternative 1
There will be no direct effects to human health and safety if this alternative is selected because no new actions will be implemented. Actions conducted under the *2009 Ice Storm Hazardous Fuels Reduction Project* will help reduce the potential severity of wildfires that may occur in the project area by removing or modifying available fuels. Prescribed fires under that project will remove available fuel from approximately 49,000 acres. Mechanical treatments will modify fuels in wildland urban interface areas and some fuels will be removed through removals approved under that project.

Competition between stems for resources will not be reduced and stressed trees will continue to decline creating additional overhead hazards for workers and visitors.

Alternatives 2 and 3
The potential for effects to public water resources and air quality in the area are also addressed in the 'Water Quality' and 'Air Quality' sections of this Environmental Assessment, respectively.

Management actions beyond those previously approved for the proposed project area would be implemented and therefore, there will be an increased potential for injury or death to forest workers during implementation of the proposed action over the no action alternative.

Information from the US Department of Labor indicates logging is one of the most hazardous occupations in the United States. Injury or death could result from improper felling of trees and the mishandling of chainsaws or logging equipment. Actions associated with timber stand and wildlife stand improvements involve the use of chainsaws, machetes, fire and herbicide and therefore, can pose serious risk. The increased potential for injury or death to workers is not anticipated to be significant, because precautions to ensure activities are conducted in a safe manner will be taken. Inspections and implementation monitoring will be conducted to ensure that loggers, other contractors, Forest Service personnel, partners and volunteers operate in compliance with appropriate Occupational Safety and Health Administration standards.

Potential job hazards are reviewed with workers prior to implementation of any activity, and entry into areas where active operations are occurring will be restricted to the public.

Burning and thinning activities to regulate overstory density and to promote establishment and survival of regeneration will reduce the quantity of available fuel in the area and subsequently will reduce the potential severity and extent of a wildfire should it occur. Safer conditions for Forest Service personnel conducting future prescribed burning activities or responding to wildfire in the area will exist following these actions. Smoke sensitive targets could still be impacted during a wildfire, but emissions would be anticipated to be less than those generated in an area where no reduction in fuel loading had occurred. When conducted within the prescribed elements of a burn plan and with the utilization of smoke management program guidelines, no significant effects to human safety from smoke generated by burning operations are expected In addition, because more open conditions will exist following prescribed burning, safer conditions for crews conducting vegetation management actions and for forest visitors will also result.

More overhead hazards caused by ice storm damage will be removed through commercial timber sales and non-commercial timber and wildlife stand improvement actions under these alternatives than under the no action alternative; competition between stems will be reduced, but injured trees will continue to succumb to injury and environmental stresses.

Herbicides are one of the management tools used on the Ozark-St. Francis National Forests to control competing vegetation. The land area treated with pesticides by the Forest Service is a very small percentage of the total forest and rangeland area within the National Forest System lands. (http://www.fs.fed.us/foresthealth/pesticide/policy.shtml) It is impossible to eliminate all risks associated with herbicide use, but foreseeable risks to physical and biological environments and human safety can be significantly reduced through use of low application rates, selective application methods, monitoring and operating in compliance with applicable Forest Plan standards and the manufacturer's label requirements. These measures are required for the action alternatives.

Virtually all substances can be toxic. It is the dose level and the conditions of exposure that make their effect toxic or harmful. Toxicity of a substance is divided into four categories: acute, sub-acute, sub-chronic and chronic.

Acute toxicity results from a single dose of a substance through ingestion, inhalation, skin or eye exposure. Sub-acute, sub-chronic, and chronic toxicity may potentially result from repeated exposure to a substance for a period of time. Sub-acute toxicity is based on repeated exposure for one month or less; sub-chronic toxicity is based on repeated exposure for one to three months, and chronic toxicity is based on repeated exposure for more than three months. It is not uncommon for toxic effects of repeated exposure to a substance to differ from toxic effects from a single exposure.

Judgments about the potential hazards of herbicides to humans are based in large part on the results of toxicity tests on laboratory animals. Studies are conducted on non-target species such as birds, mammals, and aquatic organisms with focus on specifics such as reproductive effects,

bioaccumulation of a chemical in edible tissues of game animals or fish and impacts of a chemical on animal habitat. Information on effects on humans supplements the laboratory animal test results where such information is available.

Federal law requires that before selling or distributing a pesticide in the United States, a person or company must obtain a registration or license from the US Environmental Protection Agency. Before registering a new pesticide or new use of a registered pesticide, the US Environmental Protection Agency must first ensure that the pesticide (including any adjuvants, surfactants, or other ingredients comprising the product contents), when used according to label directions, can be used with a reasonable certainty of no harm to human health and without posing unreasonable risks to the environment. The US Environmental Protection Agency continually assesses the effects of herbicide use on the environment and public health as part of the required registration process for individual chemicals and their specified uses as well as to maintain approved uses over time. For product registration and re-registration, the US Environmental Protection Agency requires that many of the toxicity tests be conducted at exposure rates well above any product label use rates. Discussion of toxicity endpoints evaluated and a review of relevant toxicological literature are presented in the respective cited risk assessments (USDA FS 2011 a, b, and c respectively) which are publicly available on the internet at http://www.fs.fed.us/foresthealth/pesticide/risk.htm and have been incorporated by reference.

Each of the respective cited risk assessments used extensive literature searches and unpublished studies submitted to the US Environmental Protection Agency to support registration of the herbicides proposed for use. Measures of risk were based on typical Forest Service uses of each herbicide. Human health risk characterizations for the herbicides proposed for use in this project are summarized below; there is no evidence that typical or accidental exposures to the herbicides proposed for use will lead to dose levels that exceed the level of concern.

There are no municipal water intakes within 300 feet of any area to be treated with herbicide and Forest Plan standards for herbicide application will be observed so no effects to municipal water sources are anticipated.

Glyphosate

Glyphosate is non-irritating to slightly irritating to eyes if direct contact occurs; no permanent eye damage has been rported. Inhalation is not an important route of exposure due to this herbicides low volatility. Glyphosate is poorly absorbed through the skin. It is classified as a Group E pesticide by the US Environmental Protection Agency, meaning there is evidence of non-carcinogenicity for humans. Adverse reproductive effects have not been noted.

Triclopyr

Triclopyr may cause irritation to eyes. Inhalation exposures are not of toxicologic concern; the ester formulations can be volatile and care should be taken during applications. The amine formulation is much less volatile than the ester formulation. Triclopyr may cause skin irritation. The US Environmental Protection Agency has determined evidence for carcinogenicity is marginal (Group D pesticide). Triclopyr does

not produce reproductive or developmental effects at doses that do not produce maternal toxicity.

Imazapyr
Imazapyr is mildly irritating to eyes upond direct contact. Imazapyr is mildly irritating to skin; data do not suggest that systemic toxic effects are plausible after dermal exposures to imazapyr. This chemical does not readily volatize. Imazapyr is classified as a Group E pesticide by the US Environmental Protection Agency, meaning there is evidence of non-carcinogenicity for humans. There is no evidence of reproductive risks from use of imazapyr.

The lowest known effective rate of each herbicide will be used for this project; the amount of herbicide applied—either in a single dose or in successive doses within the same year—will not be higher than that specified on the manufacturers' labels. Prescribed burning and thinning activities will remove some of the above ground vegetation reducing the amount of vegetation to be treated and consequently also reducing the potential for any adverse effects to the human and natural environments. Herbicide handling, mixing, and application protocols and practices make chronic exposures or cumulative effects unlikely.

Many things can contribute to risk when looking at herbicide applicators. The most concern can be related to the amount of time a worker is exposed to the herbicide. Typical occupational exposures may involve multiple routes (i.e., oral, dermal and inhalation); dermal exposure is generally the predominant route for herbicide applicators. Long hours wearing contaminated gloves or a long length of time before spills are cleaned off hands or legs will contribute to higher levels of risk. Observance of reasonable and prudent handling practices which include use of personal protective equipment and personal hygiene will reduce the potential for exposure to chemicals at levels that may be regarded as unacceptable are required. An appropriately trained Forest Service employee will be present while workers apply the herbicide to ensure that reasonable and prudent handling practices are used and compliance with regulations involving herbicide use is met.

Individuals from the public could be exposed by direct spray, skin contact with contaminated vegetation, or consumption of contaminated fish, fruit, vegetation, or water. For this project, Forest visitors will not be permitted in areas during any active operation. A trained Forest Service person or persons will be on site during herbicide applications reducing the potential that a person might enter a treated area. The US Environmental Protection Agency requires a restricted entry interval of 12 hours for both glyphosate and imazapyr herbicides and of 48 hours for triclopyr without specific personal protective equipment for uses within the scope of the Worker Protection Standard for Agricultural Pesticides (40 CFR 170). To ensure this requirement is met and to reduce the potential for accidental exposure, neither visitors nor forest workers will be permitted in areas treated with herbicide for 48 hours following application of any herbicide. Signs will be posted to this effect.

Human consumption of contaminated vegetation (fruit, nuts, etc) is unlikely to occur. Only woody stems and foliage will be treated for this project. It is unlikely that woody stems or

foliage of the treated plants will be consumed by humans in any quantity. Treated vegetation will begin to display signs of damage and will die, making foliage or fruit of plants unappealing for short term consumption and unavailable for long-term consumption.

Because chemicals will not be mixed or dispensed into backpacks or squirt bottles near any body of water, contamination of a or stream is only likely occur if a vehicle transporting concentrated herbicide was involved in a severe vehicle accident. This is not likely to happen because no more than the amount of herbicide needed to accomplish a single day's work will be transported to the work site; the herbicide would be transported by the Forest Service employee supervising the operation.. In the event that a spill occurrs protocols outlined in the District's Pesticide Emergency Spill Plan would be implemented immediately. After an accidental spill, the affected area would be clearly posted and entry restricted to limit the potential for exposure.

No adverse direct or indirect effects or cumulative impacts on human safety are expected if either of these alternatives is implemented as planned.

Heritage Resources

A complete inventory of Heritage Resources (Jurney and McCluskey 2010) within the project area has been done (Indiana Bat Environmental Assessment-Heritage Resource Inventory Report, #12-10-01-01) and is on file in the project planning record. There have been 410 sites recorded in the project area. This yields a site density of 1/188 ac, which is slightly less dense than the Forest-wide average of 1/132 ac (Jurney et al. 2010).

The National Historic Preservation Act of 1966, as amended requires Federal agencies to take into account the effects of their undertakings on historic properties and afford the Advisory Council on Historic Properties a reasonable opportunity to comment on such undertakings. Additionally, federal agencies are required to follow the implementing regulations of the Advisory Council on Historic Properties set forth in 36 CFR Part 800. Specifically, 36 CFR Part 800 requires that State Historic Preservation Officers and Tribes be consulted about any undertaking that has the potential to affect historic properties, and properties of religious or cultural significance to Tribes, at the earliest possible stage in the development of those undertakings and throughout the planning and implementation processes of those undertakings. The National Historic Preservation Act Section 106 review process seeks to accommodate historic preservation concerns with the needs of Federal undertakings through consultation amongst Federal agencies, State Historic Preservation Officers, Tribal Historic Preservation Officers , federally recognized Tribes, Advisory Council on Historic Properties and other consulting parties (e.g., state agencies and city and county governments), and the public. To provide for early consultation on the design of projects, the scoping process of the National Environmental Policy Act of 1969 as amended (83 Stat. 852 et seq.; 42 U.S.C. 4321-4347) has been followed.

Of the 410 archeological sites known to occur in the project area, 244 are historic sites, 145 are prehistoric sites, and 21 sites have both prehistoric and historic components. Three Landtype Associations(Sylamore Boone Hills, Sylamore Hills, and White River Rolling Hills) are present.

Sites are unevenly distributed among the landtypes within the Landtype Associations, with 39.6% in the White River Rolling Hills Landtype Association, 34% in the Sylamore Boone Hills Landtype Association and 26.4% in the Sylamore Hills Landtype Association. Prehistoric property types found within each landtype association are shown in table 17 below:

Table 17: Prehistoric Property Types within the Indiana Bat Habitat Restoration Project Area by Landtype Association

Landtype Association	Prehistoric Property Type					
	Open lithic scatters and camps	Rockshelters	Caves	Caves / Rockshelters	Rockshelter cemeteries	Open site cemeteries
Sylamore Boone Hills	45.8%	40.7%	8.5%	3.4%	1.6%	--
Sylamore Hills	33.3%	26.5%	36.4%	---	---	3.8%
White River Rolling Hills	63.9%	12.5%	22.2%	---	---	1.4%

Among prehistoric sites, property types include caves (64, 32.8%), rockshelters (55, 28.2%), open air sites (72, 39%), and a natural bridge. Human burials are known and likely at many rockshelter and cave sites, and open air prehistoric cemeteries are known.

Property types among historic sites are vastly dominated by house sites and farmsteads (73.9 percent), cemeteries (5.3 percent), and wells/springs/water facilities (3.8 percent). Other property types are incidental and include distilleries (3.1%), mines or mineral tests (2.3 percent), fields and rock piles (2.3 percent), schools (2.3 percent), livestock dip vats (1.5 percent), Forest Service Lookouts (1.1 percent), and roads with rock culverts (1.1 percent). Single occurrences (0.7 percent) are noted for barns, churches, Civilian Conservation Corps Camps and Lookouts, Forest Service Ranger Stations, stores, an ice cream stand, bridges, recreation area, sorghum cooker, rock quarry, post office, livestock pen, rock gate, rock fence, rock dam, Civil War muster camp, and Civil War picket post.

National Register of Historic Places eligibility recommendations have been made for some sites through consultation, and others will be re-evaluated during this project. Based on material culture, function, and potential to yield information important to history, 10.2 percent of historic sites are determined Listed or Eligible for Listing and 67.6 percent are recommended Not Eligible for Listing in the National Register of Historic Places. Of the prehistoric sites within the project area 26.1 percent are not eligible for listing in the National Register of Historic Places; prehistoric sites frequently require focused excavations to fully document their age, structure, and cultural associations, therefore 49.7 percent remain unidentified, with 24.2 percent Listed or Eligible for Listing in the National Register of Historic Places

The USDA-Forest Service has defined Priority Heritage Assets as a property recognized through official designation such as listing or eligibility for listing on the National Register of Historic Places, and a recommended management use in order to realize the benefits to the agency and public by its protection. The primary value comes through recognition of a Priority Heritage Asset's cultural/traditional, scientific, interpretive, and adaptive uses. The Priority Heritage Asset can be managed through preservation, enhancement, and scientific investigation. Within the project area, nine archeological sites (3BA243, 3ST0041, 3ST0068, 3ST0083, 3ST0084, 3ST0087, 3ST0194, 3ST201, 3ST206, 3ST0372) are listed as Priority Heritage Assets. Each requires periodic (at least once every five years) visits to make Condition Assessments. Four of these also have human remains and additional legal mandates, including those of the Native American Graves Protection and Repatriation Act (NAGPRA), which must be followed to protect these historical properties. The human remains are currently curated at the University of Arkansas, Arkansas Archeological Survey, awaiting disposition through repatriation or reburial. Four additional sites within the project area have NAGPRA concerns.

Direct, Indirect and Cumulative Effects

Alternative 1

Under the no action alternative, archaeological surface and subsurface site integrity within the portion of the project area not approved to receive prescribed burning treatments is subject to adverse effects from the buildup of fuel caused by ice storm damage and other natural processes and the likely decline of forest health over time. These conditions pose the potential for increased tree mortality and high intensity wildfire occurrence. Fires occurring in areas with dense concentrations of combustible material have the potential to burn with greater than normal intensity and duration, thereby altering the physical integrity and/or research value of archaeological sites or site components. Resulting soil exposure can lead to an increase in erosion thus disturbing or leading to a loss of archaeological soil matrices and/or site components. With no change in current management, adverse effects and the potential for them on a number of archaeological sites may continue. Historic properties would likely continue to degrade. There would be no change in effects from the current condition, as the potential threat to integrity of cultural resources would remain unchanged. Cumulative effects of the no action alternative will continue to deteriorate historical properties.

Alternatives 2 and 3

The scope of the analysis for potential effects to cultural resources includes the entire Indiana Bat Habitat Restoration Project area. For the purposes of this analysis, where treatment types have potential to occur (see the Proposed Vegetation Management Map in Appendix B of this document), it will be assumed they will occur.

An effect to a cultural resource is the "alteration to the characteristics of a history property qualifying it for inclusion in or eligibility for the National Register" [36 CFR 800.16 (i)]. Any project implementation activity that has potential to disturb the ground has potential to directly affect archaeological sites, as does the use of fire as a management tool. Specific actions proposed that have potential to directly affect cultural resources include harvest and associated actions to extract harvested timber (construction of log landings, skid trail or temporary roads

and maintenance or reconstruction of existing roads where those actions occur outside existing right-of-way areas), prescribed burning and associated construction of prescribed fire containment line, and mechanical treatments.

Proposed activities that do not have potential to affect cultural resources and therefore, are not considered undertakings for purposes of this project include: non-commercial thinning, manual or chemical timber and wildlife stand improvements, treatment of non-native invasive plants with herbicide, maintenance of existing roads that does not take place outside existing road prisms, road reconstruction of previously surveyed roads where ground disturbance does not take place outside existing road prisms.

In general, because the under and mid stories will be in a more open condition following implementation of actions designed to reduce basal area, the potential to affect cultural resources will be increased because increased visitor use to areas of the forest in which those resources are located will be likely; thus rendering cultural resource sites more vulnerable to both intentional and unintentional damage. Intentional damage can occur through unauthorized digging in archaeological sites and unauthorized collection of artifacts from sites. Unintentional damage can result from driving motorized vehicles across archaeological sites (though this activity is prohibited on all areas except authorized roads open to that use), as well as from other activities related to dispersed recreation uses that lead to ground disturbance. Effects may also include increased or decreased vegetation on protected sites.

Reducing stem density of forested areas through the vegetation management activities proposed can impact cultural resources. Previously undiscovered surface artifacts or features may be inadvertently exposed, disturbed or damaged. Project design (see Appendix A) includes protective measures to be applied to cultural resource sites that are unevaluated, eligible for listing or listed in the National Register of Historic Places as well as measures that apply to inadvertent discovery of sites with human remains (see Appendix J).

At a minimum known historic properties will be protected through avoidance. All sites Listed, Eligible, and Undetermined for the National Register of Historic Places will be protected as if all are listed on the National Register. These sites will be protected from ground disturbing activities and intense prescribed fire. For Not Eligible sites, no further work or protection is needed. A qualified archaeologist will provide any other site specific mitigation measures needed to protect historic properties during development of annual programs of work. Known or discovered properties will be monitored to ensure protection measures are implemented.

All Indiana bat hibernacula are to be evaluated for emplacement of gates under these alternatives, which increases the concern for significant Heritage sites and Native American Sacred Sites or burial sites. When protocols for monitoring the effects of cave gate installations are in place, hibernacula will be evaluated for gating. If gates are determined to be needed to protect hibernating bats from human disturbance, Native American tribes will be invited to participate in development of plans to install those gates so that inadvertent impacts to sites may be avoided.

When the proposed activities are implemented as designed, negative impacts to historic properties within the project area are not expected to result. Project scoping and analysis have not identified any definitive plans for use on non-National Forest lands within the project area. Cumulative effects to cultural resources are not expected to occur if Alternative 2 or Alternative 3 options are selected.

Scenic Values and Recreation

Protecting scenery is integral to the economic vitality of local communities and the quality of life for both residents and tourist traveling through the Sylamore District of the Ozark-St. Francis National Forest. Scenery is particularly important to those visitors hiking the many trails throughout the district, biking on over 50 miles of bike trails, horseback riding, camping at any of the District's three developed campgrounds, or driving through on the way to visit Blanchard Springs Caverns, one of the largest economic draws on the Forest.

For this analysis short term effects will be considered as those which last between f 0-10 years, and long term effects will be considered as those which last between 10-100 years following completion of an activity.

The project area is made up of a series of mostly gravel roads winding through a mosaic of uses and management areas. The Recreation Opportunity Spectrum classifies most of the areas as "Roaded Natural", defined in the Recreation Opportunity Spectrum User Guide as an "area … characterized as predominately natural-appearing environments with moderate evidences of the sights and sounds of man", with some "Semi-Primitive Motorized" areas, defined as an "area… characterized by a predominantly natural or natural-appearing environment of moderate to large size", concentrated near the Sylamore Experimental Forest and the Clifty Canyon Special Interest Area (near the western border of the project area). Two other special interest areas lie at the north (City Rock Bluff) and central (Sandstone Hollow) portions of the project area.

North Sylamore Creek, 14.5 miles of which are congressionally designated as a Scenic River and a State of Arkansas Extraordinary Resource Water, runs through the southeastern corner of the project area. The North Sylamore Creek Wild and Scenic River Management Plan, signed in 1996, calls for protection and enhancement of "remarkable values identified as recreation, fish, wildlife and botanical", as well as providing for plant and animal community diversity, recognizing and responding to socio-economic effects of management actions, and emphasizing user education. Private land makes up the remainder of the mosaic, and is particularly concentrated around the north and south edges of the project area.

Scenic character of the Indiana Bat Habitat Restoration Project area is dominated by three major scenery attributes: (1) continuous forest cover of mixed hardwood-pine forest offering largely foreground views, (2) continuous forest cover of hardwood riparian forests and (3) glade ecosystems with shallow soils, low grassy understories and open canopy pine, cedar or hardwoods. All three types of scenery, but particularly the glade ecosystems, are punctuated by dramatic limestone outcroppings, ranging from below one foot to rising 5-10 feet above the forest floor. Vegetation is the major scenery attribute of the area with large trees, ephemeral flowers and texture and color variety amongst species offering further scenic accents. Minor scenery attributes include occasional long distance views through the more open canopy forests and at City Rock Bluff.

The project area has a wealth of recreation opportunities, and draws mountain bikers, hunters, fisherman, hikers, campers and persons seeking guided tours through Blanchard Springs Caverns

from the local area and from around the country. The most concentrated recreational uses of the area are clustered around the Blanchard Springs Caverns Complex in the southeastern portion of the site. The caverns are a local and national tourist destination; the facilities and recreational opportunities built around it are well suited for large gatherings, daily use by visitors, camping and swimming in the scenic North Sylamore Creek.

Campers may select from two campground further removed from the Blanchard Springs Complex. Gunner Pool Campground is a bit further north along North Sylamore Creek, and the Barkshed Campground offers creek-side camping a bit further northwest. The area provides for dispersed camping as well. Trails throughout the project area draw not only hikers, but also mountain bikers who enjoy over 50 miles of trail designed for biking and hiking. Horseback riders make use of less trafficked roads and the forest interior.

Deer, squirrel and turkey hunting are also popular in the project area. Motorized traffic is restricted during nesting and brooding seasons in the 9,371 acre Sylamore walk-in turkey hunting area, which is completely contained within the project area.

The Sylamore Scenic Byway occupies part of Arkansas state highways 14 and 5, and snakes east to west across the southern portion and up the eastern portion of the project area. This Scenic Byway, whose scenic character is dominated by forest vegetation flanking limestone bluffs and streams, and private inholdings, offers views into the Ozark Mountains.

An interdependence exists between aesthetics and ecological systems. A sustainable, healthy forest promotes aesthetic, natural-appearing landscapes. Desired conditions for the project area's recreational opportunities are that they continue to appear very natural in both the short and long term, and the forest structure and composition reflect diverse, healthy, resilient ecosystems. Access to all recreational facilities should be maintained, as are the Recreation Opportunity Spectrum class specifications of "Roaded Natural" and "Semi-Primitive Motorized". Recreational users should encounter less overall hazard through the maintenance of healthier forest with fewer hazard trees.

The *Indiana Bat Habitat Restoration Project* area is made up of three predominant vegetation types: Dry Oak Forest and Woodland; Dry-Mesic Oak Forest and Shortleaf Pine-Oak Woodland with less than 1% each of Mesic Hardwood Forest, Riparian Forest, and Loblolly Forest. The majority of the area falls within the "Mixed Forest" Management Area (3C) as outlined in the Forest Plan. Historically, wildfires and burning by Native Americans helped maintain a moderately open canopy with an understory of young hickory and pine species. Fire suppression in the 20th century led to closed canopies, dense stands and a shift in the understory composition and structure, with a shade tolerant mixture of dogwood, black gum and maple that can out compete regeneration of slower growing oaks and hickories for position in the overstory. Glade areas have shifted towards forested ecosystems and away from their historic structure of scattered cedars, pines or oaks over herbaceous understories of grasses, forbes and legumes.

The majority of the forests within the project area, especially those outside of riparian corridors, have become too dense to sustain a healthy and resilient ecosystem.

Furthermore, this density has led to a decline in tree health, leaving the area susceptible to high intensity wildfire and disease outbreak, which could have devastating short and long term scenery impacts. An examination of the Fire Regime Condition Classes within the project area further supports that many of the ecosystems have moved outside of the natural range of variability. As is depicted in the map below, most of the project area has departed from the historic fire regime with low intensity fire returning every 0-35 years (Figure 6).

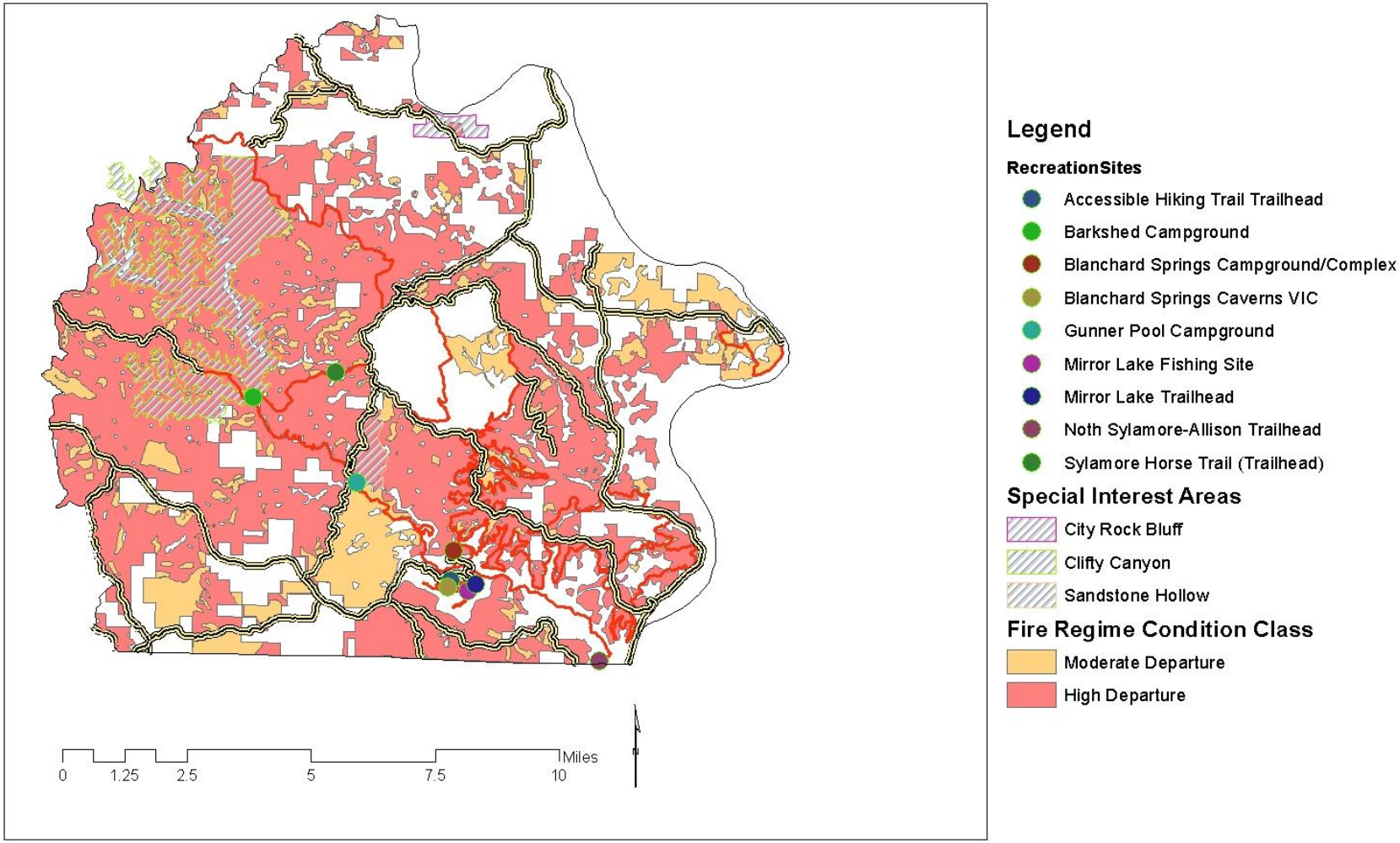


Figure 6 Fire Regime Condition Class Data shows over 75% of the landscape departs from historic fire regimes

The health of the area was further degraded by an ice storm in 2009 that damaged many mature oaks, affecting their ability to produce mast, and making them more susceptible to insects and disease attack. Subsequently these conditions reduce the potential for the establishment of oak-hickory regeneration in the understory. Damaged trees may persist for years blocking sunlight to and competing with the oak-hickory regeneration that is present. Without intervention, these forests may transition to a denser, shade tolerant understory, blocking middle and background views and decreasing scenic enjoyment of the area.

The denser vegetation also obscures middle and background views from the area, and degrades foreground views by decreasing complexity and instead presents a dense mesh of uniform vegetation. In one section of the project area where thinning was implemented under previously approved project, a sweeping vista of the valley and mountains beyond was revealed. There are key opportunities to reveal similar views throughout the ridge tops within the project area.

The aesthetically ideal Scenic Character for the forest and woodlands in the Indiana Bat Habitat Restoration Project Area would include a diversity of forest successional classes. Periodic fire, and other vegetation management treatments combined with natural topographic variation and geological features, would create a mosaic of understory age and composition. In mature stands a more open forest canopy with mid- and understories composed of advanced hardwood or pine regeneration and a diverse range of native woody and herbaceous species. Standing and downed snags would be evident. Non-native invasive plants would be a minor component within the project area. Because fire is a part of the natural ecosystem, the effects of fire should be considered a part of the natural viewshed.

In the glade ecosystems, the ideal Scenic Character would display occasional cedar, shortleaf pine, or white oak trees over a predominately herbaceous understory, including many plants that are found only in the glade ecosystem. Rock outcroppings would serve as a predominant feature in this landscape as opposed to an occasional accent. Riparian ecosystems would remain largely unaltered from their current state with occasional single tree removal providing canopy gaps. These open aesthetics are in line with research on human preference for forested landscapes. In general, humans prefer openings in forests due to the fact that they can see further in the landscape (Ribe, 1989).

The project is viewed primarily from public roads, recreation sites and trails throughout the project area. Most of these areas offer foreground and middle ground views, with roads and trails along ridgelines offering glimpses of sweeping background views of valleys and mountains. Of particular concern will be views from the Blanchard Springs Cavern Complex, the Syllamo trail, Green Mountain road (off which many trails begin), Barkshed Campground, Gunner Pool Campground, the Sylamore Scenic Byway, and the three Special Interest Areas.

- ***Green Mountain Road:*** Views from Green Mountain road have a predominantly natural appearance, with some private lands interspersed. This area has moderate scenic integrity predominately due to timber sales and damage from the 2009 ice storm that have occurred along the roadside. Non-native invasive plants are evident along this and other

roads in the project area; the most common are Sericia lespedeza, tree of heaven and princess tree. The road offers primarily foreground and middle ground views of vegetation, with the occasional background vista through thinned tree canopies.

- ***Blanchard Springs Cavern Complex:*** The Blanchard Springs Caverns complex has high scenic integrity. The landscape is a mosaic of dramatic cliff faces, scenic waterways, and well maintained recreation facilities. Views range from close up interactions with vegetation, waterways and geologic features to middle and background views of mixed hardwood-pine forests. This complex draws a high number of visitors as it is anchored by the beautiful Blanchard Springs Caverns.
- ***Syllamo Trail*****:** The Syllamo trails snake through the southeastern portion of the project area, offering close up interaction with vegetation, as well as middle ground views. The scenic integrity of the trail corridor is moderate as felled hazard trees are a common site. Damage from the 2009 ice storm, timber harvests and timber stand improvement treatments have disrupted the line and form of the forest in parts.
- ***Barkshed and Gunner Pool Campgrounds:*** The scenic integrity of these areas is moderate to high. Foreground and middle ground views of vegetation, rock outcropping, cliff faces, and water features are disrupted only by recreation facilities that blend well into the surrounding landscape.
- ***City Rock Bluff Special Interest Area:*** This is an area of high scenic integrity with scenic experiences ranging from close up interactions with glade flora and fauna to sweeping vistas of forest, homes and towns.
- ***Sandstone Hollow Special Interest Area***: This is an area of moderate scenic integrity. The forest is moderately open, offering views into the forest for several hundred yards.
- ***Clifty Canyon Special Interest Area:*** This is an area of high scenic integrity with foreground and middle ground views of vegetation, rock outcroppings and running water. A 1,922 acre portion of this Special Interest Area is currently managed as a Roadless Area though it has not been congressionally designated as such.
- ***Sylamore Scenic Byway:*** This is an area of high scenic integrity. While the majority of the view is of mixed hardwood and pine forest, the landscape is punctuated by limestone outcroppings, private in holdings and streams.

Scenic integrity objectives across the landscape follow landforms. The project landscape has a scenic integrity objective of "high" along ridgelines, near the Blanchard Springs Caverns Complex, the Sylamore Scenic Byway and along the scenic North Sylamore Creek. The scenic integrity objective is low along other bottomlands where views are impeded by slopes (Figure 7).

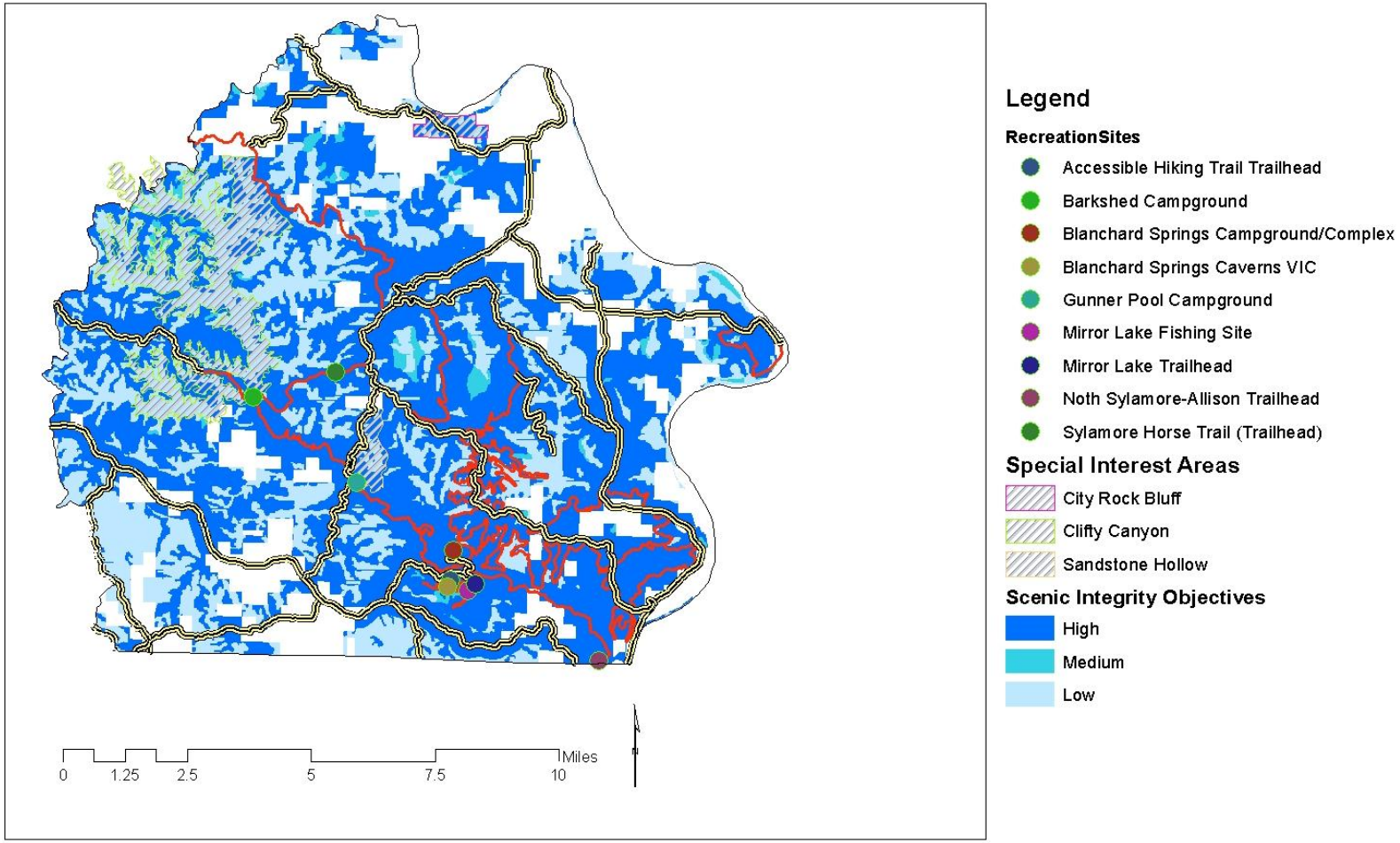


Figure 7: A map of project area Scenic Integrity Objectives shows that much of the project area has a "high" scenic integrity objective

Scenic stability is the degree to which culturally significant or preferred scenic landscape character can be sustained into the future. Many of the scenic accents (rocks, waterways) in the project Area are relatively static. However, vegetation, the major scenic attribute of the area, is subject to change over time as the result of disturbance events such as wind storms, ice storms, high intensity wildfire, widespread insect infestations and disease outbreaks and human activity. Scenic stability definitions are provided in Appendix K of this document.

The scenery in the project area is predominately "low stability". While the desired dominant species of oak and pine exist in much of the area, the composition and structure of forest lands has shifted well beyond the ideal scenic character. Forest density beyond the historic range of variability occurs across the majority of the project area, leaving the forests susceptible to insect and disease infestation and high intensity wildfire during periods of extended drought. These events could have devastating long and short term impacts on vegetation, and lead to the degradation of much of the sensitive views and scenic character in the area.

Direct, Indirect and Cumulative Effects

Scenery effects of the proposed alternatives will be discussed in regards to scenic character, scenic integrity, and scenic stability. Scenic integrity will be considered primarily from the sensitive viewing areas discussed above. Both short (10 years) and long (100 years) impacts will be considered.

Alternative 1

The existing scenic character would continue to degrade as forest health declines due to overcrowding of canopy, mid-story, and understory vegetation. Eventually the shade cast by the closed canopy of the over story would lead to a shift in forest composition towards shade tolerant species, moving the landscape further away from the desired scenic character. The existing and potential future density would also leave the forest susceptible to disease and insect outbreaks, and high intensity wildfire during periods of drought, which could destroy the scenic forest character in the short term and seriously alter it in the long term. Furthermore, non-native invasive plant species would not be treated in areas not previously approved for that action, increasing potential for them to spread and displace native species.

No treatments beyond those previously analyzed and approved through other projects would be applied to the landscape. In the short term, stands recently treated through other projects would begin to take on a more natural appearance through the degradation of brush and regrowth of understory. In both the short and long term, there would be an increased risk of losing scenic integrity through high intensity wildfire or an extensive insect or disease outbreak.

Currently, the landscape within the project area is classified as "low stability" as the overcrowding of vegetation will lead to a decline in forest health and resiliency. If no action is taken to decrease the density of the forests, it is possible that a disturbance event, such as high intensity wildfire or windstorm, could alter the forest vegetation by allowing shade tolerant

species to out compete desirable oak and pine species, lowering the scenic stability to "very low stability".

Alternative 1 will not produce any direct adverse scenery effects, but will also not move the project area towards the desired scenic character. Views from sensitive areas would remain intact with dense vegetation punctuated by running water and limestone bluffs. Indirect effects may include an eventual decrease in the scenic character and scenic integrity through natural processes. This change would be more rapid if a stand replacing event occurred.

This alternative will not generate adverse direct effects on recreation within the project area. In the long-term indirect effects may include an increase in hazard trees in recreation areas due to declining forest health. Furthermore, shifts in species composition, overcrowding of stands, and declining diversity as canopies close could negatively impact recreation and hunting. These same effects of declining forest health could lead to a decline in scenic character, impacting recreationist's enjoyment of the area.

No immediate adverse impacts to the North Sylamore Creek Wild and Scenic River values would occur. In the long term, however, botanical values could be impacted as shifts in species composition occur and non-native invasive species advance.

Alternative 2

Design interventions adapted from the US Forest Service Region 8 Scenery Treatment Guide (2008) were incorporated into the project's design to mitigate effects to scenery caused by implementation of the proposed activities (see Appendix A).

Alternative 2 would likely have a negative short-term impact on scenic character, but a positive impact in the long-term. In the short term, timber harvesting, timber stand improvement and wildlife stand improvement treatments would alter foreground views, both positively by decreasing forest density, and negatively by increasing the amount cut material (slashed to below 2') on the site. Within five years repeated burn cycles, degradation of slash material and regeneration of understory vegetation would minimize any evidence of mechanical treatments. Evidence of prescribed fire, in the form of burn marks on large tree trunks and charred debris would be evident. However, fire is a natural part of the ecosystem, and this effect should be considered a natural part of the viewshed.

Herbicide treatments would also have a negative impact on scenic character in the short-term, but would likely accelerate the pace at which the landscape moves towards the desired more open-forest scenic character. Dead roadside and understory vegetation would persist until it is overgrown by other species or is consumed during prescribed fire. In areas of with high Scenic Integrity Objective designations and along roads that receive high volumes of visitor use cut stump treatments could be used to mitigate this issue; stems would be cut prior to herbicide application to the stump so there would be no standing dead material. In the long term, timber stand improvement treatments with herbicide will effectively reduce competition between regeneration of over story species and other woody stems. This increase in the pace of regeneration would likely help the project area reach the desired landscape condition sooner than

if herbicide was not used as non-native invasive species presence would decline, leading to benefits for natives species. Increased sunlight to the forest floor would also encourage the regeneration of grasses and flowering species.
In the long-term, Alternative 2 would likely have positive impacts on scenic character, creating more open foreground and middle ground views, and in some locations opening up site lines for long distance views into the valley and mountains beyond.

The treatments outlined in Alternative 2 will decrease scenic integrity in the short term but lead to an overall increase to "high" scenic integrity in the long-term. Immediately after a burn, mechanical treatment or herbicide application, the scenic integrity level may remain at "moderate" or even drop to "low" as the disturbance to the scenic character becomes quite evident, especially in areas with foreground and middle ground views. However, after a growing season, the negative visual impact of each of these treatments will become less evident through decomposition of slash material and growth of understory vegetation. In the long term, the scenic integrity of the site will be increased by the reintroduction of long distance views and more pleasing fore and middle ground views into the less dense forest. Removal and treatment of non-native invasive species would also promote higher scenic integrity by preventing species such as tree of heaven from blocking middle and long distance views.

The treatments outlined in Alternative 2 would increase scenic stability in the project area to "high". By thinning the current vegetation through mechanical treatments, prescribed fire and herbicide application, the forest will be more resilient against high intensity wildfire, disease outbreak, insect infestation, and general forest health decline. The treatments would have little to no impact on the more static scenic attributes, like rock outcroppings and waterways.

The treatments proposed in Alternative 2 would produce immediate direct adverse effects on the scenic integrity and scenic character of the project area, especially when viewing the project area from the Syllamo trail or Green Mountain road. Treatments would immediately increase scenic stability, and in the long run would increase both scenic character and scenic integrity through the restoration of a more resilient, open canopy ecosystem. The landscape that would likely result from these treatments would be aesthetically pleasing, healthy and ecologically sustainable in the long-term, creating more sustainable scenery into the future.

The treatments outlined in Alternative 2 would open the canopy around the trails in the area. This may lead to an increase in vegetation encroachment on trails as more sunlight reaches the forest floor, including along the much used Syllamo trail loops. This could be avoided by leaving denser vegetation along the trails provided it does not pose a safety hazard.

Alternative 2 would generate new opportunities for education and recreation on the Forest. For example, treatments near Blanchard Springs Cavern Complex could be interpreted via podcasts available on the Forest website free of charge. Recreationists visiting the cavern complex could download the podcast prior to their visit, and learn about the natural and cultural history of the area, as well as the treatments they may see evident in the landscape, as they drive into the complex or hike the trails within it.

Treatments near North Sylamore Creek will likely include the removal of individual trees, occasional manual treatments, prescribed fire, and treatment of non-native invasive species using an herbicide labeled for aquatic use. No positive or negative impacts on the character or values of the wild and scenic river and anticipated.

Alternative 3

Design interventions adapted from the US Forest Service Region 8 Scenery Treatment Guide (2008) have been incorporated into the project's design to mitigate effects to scenery caused by implementation of the proposed activities (see Appendix A).

Much like Alternative 2, Alternative 3 would likely have a negative short-term impact on scenic character, but a positive impact in the long-term. Treatments including timber stand improvement, timber harvest and prescribed burns would be visible in foreground and middle ground views for about five growing seasons, with decreasing impact on scenic character over time. In the long term, these treatments would bring the project area closer to the desired landscape condition of a more open canopy forest.

Herbicide treatments would be limited to treating non-native invasive plants, and could have a perceived negative impact on scenic character in the short-term, but less so than with alternative 2. Unlike alternative 2, herbicide would not be used for timber stand improvement or wildlife stand improvement treatments leading to less dead vegetation in the forest understory. However, not treating understory vegetation with herbicide may mean treatments will take longer to carry out, leading to a longer disruption of scenic character. Herbicide treatments under this alternative will still produce dead vegetation along roadsides, but timing application with growing seasons of native vegetation could limit the negative scenic impact by allowing native vegetation to quickly grow in.

In the long-term Alternative 3 would likely have positive impacts on scenic character, creating more open foreground and middle ground views, and in some locations opening up site lines for long distance views into the valley and mountains beyond. Non-native invasive species would also be removed, opening up views into the forest and benefiting native understory species like wildflowers and grasses.

The treatments outlined in Alternative 3 will decrease scenic integrity in the short term but lead to an overall increase of "high" scenic integrity in the long-term. Immediately after a prescribed burn or mechanical treatment, the scenic integrity level may remain at "moderate" or even drop to "low" as the disturbance to the scenic character becomes quite evident. However, after several growing seasons, the negative visual impact of each of these treatments will become less evident through degradation of slash material and growth of understory vegetation and ground cover. It should be noted that in the absence of herbicide, more manual and mechanical treatments and fires may be needed to treat forest communities to achieve similar results, and this may increase the number of growing seasons that disturbance is evident in the landscape.
As with Alternative 2, in the long term the scenic integrity of the site will be increased by the reintroduction of long distance views and more pleasing fore and middle ground views into the less dense forest.

Treatments under alternative 3 will have a similar impact to scenic stability as those treatments in Alternative 2. By thinning the current vegetation through mechanical treatments and prescribed fire the forest will be less susceptible to high intensity wildfire, disease outbreak, insect infestation, and general forest health decline—all of which negatively affect scenic stability. The treatments would have little to no impact on the more static scenic attributes, like rock outcroppings and waterways. However, reaching a "high" level of scenic stability would take more time under this alternative as all understory treatments would be done through manual and mechanical methods and prescribed burns.

The treatments proposed in Alternative 3 would produce less immediate direct adverse effects on the scenic integrity and character than Alternative 2 because vegetation treated with herbicide would not be left standing in the understory. However, using only manual and mechanical treatments and prescribed burning may extend the amount of time it takes to complete restoration, and therefore the time in which the landscape shows disturbance. Treatments would immediately increase scenic stability, though not as quickly as with Alternative 2, and in the long run would increase both scenic character and scenic integrity through the restoration of a more resilient, open canopy ecosystem.

As with Alternative 2, the treatments outlined in Alternative 3 would open the canopy around the trails in the area. This may lead to an increase in vegetation encroachment on trails, including the much used Syllamo Trail. This could be avoided by leaving denser vegetation along the trails.

Alternative 3 would, like Alternative 2, generate new opportunities for education and recreation on the Forest. For example, treatments near Blanchard Springs Cavern Complex could be interpreted via podcasts available on the Forest website free of charge. Recreationists visiting the cavern complex could download the podcast prior to their visit, and learn about the natural and cultural history of the area, as well as the treatments they may see evident in the landscape, as they drive into the complex or hike the trails within it.

Treatments near North Sylamore Creek will include the removal of individual trees, occasional mechanical treatments, low intensity fire, and treatment of non-native invasive species using an herbicide labeled for aquatic use. No positive or negative impacts on the character or values of the scenic river and anticipated.

Transportation System

Within the Indiana Bat Habitat Restoration Project area there are 488.44 miles of authorized road. These include State, County, and Forest Service jurisdiction roads. The current conditions of these roads vary from well-maintained roads to roads that are overgrown and no longer accessible. All existing authorized roads may be used to facilitate management activities of the *Indiana Bat Habitat Restoration Project*.

Table 18: Miles of Authorized Road by Jurisdiction in the Analysis Area

Jurisdiction	Miles
County	92.36
Forest Service	363.90
Private	1.31
State	31.43

Forest Service roads are categorized into maintenance levels. Maintenance levels define the level of service provided by, and maintenance required for a specific road. The maintenance levels as described by FSH 7709.59 and the miles of each maintenance level within the project area are:

Table 19 illustrates the breakdown of authorized roads within the analysis area by maintenance levels. The maintenance levels show the type of traffic that a particular road has been designed for and how much use is expected. The breakdown of maintenance levels in the analysis area indicate that the road system was designed for limited traffic. Level 1 roads were to be closed after completion of management activities.

Table 19: Miles of Authorized Road by Maintenance Level in the Analysis Area.

Maintenance Level*	Use	Miles
1	Intermittent use to conduct management actions. Closed to Motorized use by the public.	173.65
2	Use by high clearance vehicles. Not suitable for passenger cars.	187.70
3	Will sustain passenger vehicle use, but the surface is not smooth.	26.71
4	Suitable for passenger vehicles; surface is smooth.	46.28
5	Suitable for passenger vehicles; surface may be paved.	54.66

The project record includes a roads analysis outlining details for each authorized road within the analysis area.

Table 20 illustrates the miles of road maintained through contract or completed through agreements with county governments per watershed within the analysis area; it covers a three year period. It does not include maintenance performed by purchaser through timber sales.

Maintenance may include road blading, brushing, and repairs. Repairs may include activities such as aggregate placement, shaping the road bed, pulling the ditches, and replacement or installation of drainage features. The increase in miles maintained in 2010 was atypical. Additional funding allowed the District to hire contractors to clear roads and ditches of debris and remove snags to improve user safety.

Table 20: Miles of authorized roads maintained within the analysis area over a three year period.

Watershed	2010	2011	2012	Total miles within each watershed maintained between 2010 and 2012
East Twin Creek-White River	6.54	4.90	3.27	19.79
Headwaters North Sylamore Creek	89.46	40.66	30.14	205.58
Headwaters Roasting Ear Creek	0.44	0.19	0.12	1.06
Livingston Creek	48.64	40.20	26.76	154.58
Outlet North Sylamore Creek	103.69	62.74	45.18	281.42
Outlet Roasting Ear Creek	1.25	0.84	0.84	3.76
Outlet South Sylamore Creek	0.70	0.67	0.17	2.10
Sneeds Creek-White River	2.06	0.83	0.41	4.13
Sugarloaf Creek-White River	23.05	15.87	7.07	53.88
Total miles maintained each year	275.85	166.89	113.96	

Direct, Indirect and Cumulative Effects

Alternative 1

There would be no changes in the District's transportation system or in the amount of road that is legally open to the public for vehicle traffic. Routine maintenance activities would be implemented as would road reconstruction actions approved under other projects. There will be

no cumulative effects from road management actions to extract harvested timber under Alternative 1.

Alternatives 2 and 3

When an annual program of work is being planned, the condition of routes to serve as haul roads will be evaluated, and if needed, maintenance or reconstruction actions required to support the extra weight and traffic of log trucks will be determined.

Under either action alternative, haul roads would be maintained or reconstructed to support that use. Neither alternative will result in a change to the District's transportation system or in the the amount of road that is legally open to the public for vehicle traffic to ensure safe conditions are provided and to limit the amount of sediment generated.

The amount of road maintenance typically implemented in a year's time across the District will be increased by up to 15 miles. Road reconstruction would be done if necessary to support extraction of harvested timber from the project area on up to 10 miles of existing authorized road. Both activities would result in safer conditions for drivers and would help reduce the amount of sediment generated from roads. Cumulative effects, would therefore, be beneficial.

Economics and Local Communities

Stone and Baxter counties shall serve as the analysis area for Economics and Local Communities because the project area lies within them.

The land bases of Stone and Baxter Counties are 389,758 acres and 354,559 acres respectively. The Forest Service manages 61,315 of the acres within Stone County and 62,990 of the acres within Baxter County or 15.7 percent and 17.8 percent respectively of these counties' taxable land bases. (USDA Forest Service Technical Report SRS-34, 1999) Because federal lands are not subject to local property taxes, counties containing National Forest System lands receive funds through two sources to help offset this loss:

- Payments in Lieu of Taxes (PILT) are made through the US Department of the Interior. (http://www.nbc.gov/pilt/pilt/search.cfm), and
- Payments made under the Secure Rural Schools and Community Self-Determination Act of 2000 (SRS) (PL 106-393). (http://www.fs.fed.us/srs/Title-I.shtml).

Median household income in Stone and Baxter counties is lower than national and state averages. (US Census 2010) The population of Baxter County has increased significantly over the last three decades. Much of the county's growth and more than half its tax dollars can be traced to tourism and retirement as visitors often return to take up residence (Local.Arkansas.gov 2012). The economic base of Stone County includes poultry, livestock, wood products, light manufacturing and tourism (Local.Arkansas.gov 2012). Mountain View is the county seat of and largest community in Stone County. Many of the retail establishments and restaurants in Mountain View rely heavily on tourism dollars brought in primarily during the months of April through October. Draws to this small town and the surrounding area include three annual festivals, Blanchard Springs Caverns and other dispersed and developed recreation opportunities on the National Forest, and the Ozark Folk Center State Park.

In *An Economic Assessment of Arkansas' Forest Industries: Challenges and Opportunities for the 21st Century* (2005) Pelkki finds the following:

> The forest products industry is a vital part of Arkansas' economy. The industry employs 43,371 people directly in the manufacturing of solid wood products, pulp and paper, plywood, and engineered wood panels, furniture and prefabricated buildings. Service jobs in this sector include tree planting, silvicultural operations and forest management consulting. Forest industry businesses interact directly with 97 percent of all business sectors in Arkansas. The direct value of Arkansas' forest industry output is $7.4 billion dollars per year. In 41 of Arkansas' 75 counties, the forest industry ranks among the top five economic sectors in output. The largest concentration of the industry is in and around the pine-forest dominated coastal plain of Arkansas with a smaller, but locally-important concentration in the north-central Ozark Mountain region of the state. In north Arkansas, sawmills process both softwoods and hardwoods and there are numerous very small family-owned sawmills that operate only when there is a local demand for lumber or the price of lumber is high.

Direct, Indirect and Cumulative Effects

Alternative 1
Alternative 1 does not have any immediate costs associated with proposed forest management activities.

Though not quantifiable, the value of the area for those who prefer no management be done and those who seek solitude would not change from the current condition. Some standing timber and the corresponding expected potential economic return would be lost over time with mortality of trees. No contracts will be awarded and there will be no additional opportunities for local employment. Local timber purchasers will also be negatively affected.

Local economies can be influenced by revenues generated by dispersed recreation activities such as hunting. With this alternative, the area's value for game species will diminish over time and a gradual decline in revenues generated by hunting would be expected; the extent of this affect, however, cannot be accurately assessed.

Stone and Baxter Counties would still receive payments under the Secure Rural Schools and the Payment in Lieu of Taxes programs. However, the potential amount that would be returned to all counties in Arkansas containing Ozark-St. Francis National Forest lands would be reduced because no revenues from timber sales would be contributed toward the Forest's total amount of timber sale revenue generated.

Because non-native invasive plant species will not be controlled across the majority of the project area, future costs to do so will be higher because more acres will be infested. Additional costs to implement restoration of species displaced by non-native invasive plants would also be expected.

Alternatives 2 and 3
Management of natural resources on public lands has the potential to impact the economic and social status of local communities. Both alternatives are consistent with Forest Plan direction regarding local communities. Opportunities for employment through timber sales and contracts to implement other project activities will be provided, and the Forests' resources would be managed in a manner that will provide for a steady flow of goods and services over time to prevent changes in local social and economic conditions.

Both alternatives are expected to enhance habitats of species that are hunted, watched or photographed through habitat improvements and to enhance and protect the area's aesthetic appeal for tourists over the long term. The extent of future benefits on the local economies as they relate to revenues generated by dispersed recreation is difficult to accurately assess or to assign a dollar value; therefore, related immediate and future returns were not included in the analysis. The estimated value of stumpage revenues to be returned with this alternative were the only benefits considered in the analysis.

Directly, harvesting sawtimber and roundwood would support the local timber industry's need for raw material and the local residents need for affordable firewood. The treatments proposed would also provide employment for forest industry workers. Indirectly, the money that local forest industry workers earned would be circulated within the local business communities, and both alternatives will contribute revenues toward payments to Stone and Baxter Counties through the Secure Rural Schools Act and the Payment in Lieu of Taxes programs.

Because non-native invasive plant species will be controlled, under these alternatives, future costs to do so will be less than if they were allowed to spread unchecked.

Benefit/Cost ratios were estimated for harvests and associated actions based on current economic conditions. Average market values of the most recent sales on the District were applied. More information regarding the values used is in the project planning record. A Benefit/Cost ratio of 1.0 indicates anticipated forest product revenues will cover the costs of project implementation; a Benefit/Cost ratio of < 1.0 indicates anticipated forest product revenues will not cover project implementation costs and a Benefit/Cost ratio that is > 1.0 indicates anticipated forest product revenues will cover the costs of implementation and provide a positive net return which can be used to implement other approved actions. Alternative 2 has an estimated Benefit/Cost ratio of 1.45, and Alternative 3 has an estimated Benefit/Cost ratio of 1.03. Costs for sale administration, silvicultural contract administration, monitoring and sales preparation were not included in calculating the Benefit/Cost ratios because Forest Service employees will be funded with appropriated dollars each year regardless of the implementation of this particular project; formal agreements with other agencies and non-government organizations may also be sought to defray costs associated with implementation and monitoring.

Due to uncertainties regarding funding and current market values, the costs associated with sales implemented several years out are likely to change. For each harvest prescribed under this project, current values will be used to conduct a Benefit/Cost ratio analysis. Sales would be implemented only if they can be done at or above cost or through formal agreements with other agencies or non-governmental organizations.

Civil Rights and Environmental Justice

Civil Rights imply the fair and equal treatment under the law, both within the Forest Service and in relations with the public. 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. USDA is an equal opportunity provider and employer. No current issues regarding civil rights of visitors, contractors or employees related to either alternative for this project were found. Therefore, a Civil Rights Impact Analysis and statement of findings will not be conducted.

In 1994, President Clinton issued Executive Order 12898, "Federal Action to Address Environmental Justice in Minority Populations and Low-income Populations," to ensure such populations are not subjected to a disproportionately high level of environmental risk. Environmental Justice is the fair treatment and meaningful involvement of all people regardless of race, color, national origin, or income with respect to the development, implementation, and enforcement of environmental laws, regulations, and policies. Meaningful involvement means that: (1) potentially affected community residents have an appropriate opportunity to participate in decisions about a proposed activity that will affect their environment and/or health; (2) the public's contribution can influence the regulatory agency's decision; (3) the concerns of all participants involved will be considered in the decision-making process; and (4) the decision-makers seek out and facilitate the involvement of those potentially affected.

The demographic breakdown for Baxter and Stone Counties, Arkansas and the Nation is based on data collected during the 2010 census. The percentage of persons of white ancestry is higher and the percentage of persons with ancestry in other races is lower than state and national population averages for those groups.

Direct and Indirect Effects and Cumulative Impacts

<u>Alternative 1</u>
Conditions would generally remain the same. No new work would be offered for bidding. This alternative would not have any disproportionate effects to minority or low-income groups.

<u>Alternatives 2 and 3</u>
This project will not involve the introduction of new or increased fees to utilize day-use facilities on the Forest or prevent the use of the Forest by any group of persons. Activities to be contracted would be open to competitive bids including those from minority and small business contractors. No disproportionate effects to low-income or minority groups are expected.

Irreversible or Irretrievable Commitment of Resources

Alternatives 2 and 3 will not result in an irreversible commitment of resources.
Removal of native vegetation through cutting, burning or herbicide use is an irretrievable commitment of resources but would not be irreversible since any vegetation removed would be replaced either through natural regeneration processes or, for dominant overstory forest types, through planting if needed.

Potential Indiana bat roost trees and den trees used by other species will be removed through vegetation management activities, but new roosts will also be created.

Productivity of sites where temporary road, skid trail, log landing and prescribed fire containment line will be disrupted while those installations are in use, but will be returned to a vegetated state afterward.

No changes in land use or forest type will occur under either alternative. If removed through timber harvest, approximately 25 acres planted in Loblolly pine would be replaced by another pine species (Shortleaf pine) native to the area. This will not result in a conversion of forest type.

Measures have been incorporated into both alternatives to mitigate the potential for irreversible impacts to physical environments, historic properties, federally listed species and Regional Forester's sensitive listed species that may occur as a result of proposed activities.

Monitoring to ensure unintended effects to microclimates of Indiana bat hibernacula are avoided and to ensure the bats are not harmed entering and exiting the caves will be done. Monitoring to ensure treatment of non-native invasive species is effective at mitigating the potential for infestations to spread following management actions will also be done as well as monitoring to ensure measures to keep residual herbicide from entering streams are working as predicted.

Prescribed burning operations will be conducted in compliance with Forest Plan standards thus mitigating the potential for unintended ecosystem responses.

All activities will be conducted using reasonable and prudent measures to protect human health and safety.

COORDINATION AND CONSULTATION

Interdisciplinary team members contributing to this analysis are identified below. Tribal government leaders, federal and state agency officials, local officials and organizations to whom the scoping notice were mailed are also provided in this section. A complete list of private landowners within or adjacent to the project area to whom the scoping notice was mailed may be found in the project planning record.

Interdisciplinary Team Members:

- Dr. William Carromero, Forest Ecologist
- Steve Duzan, Forest Planning Biologist and NEPA Coordinator
- Jan L Franks, NEPA Coordinator, Sylamore and St. Francis Districts
- Dr. David Jurney, Forest Archaeologist and Heritage Program Manager
- Judith Logan, Air Quality Specialist, Western Zone, Region 8
- Sue McCluskey, District Archaeology Technician (retired 2012)
- James R. McCoy, Ranger, Deciding Official, Sylamore and St. Francis Districts
- Richard Monk, Forest Hydrologist
- Scott Osborne, District Fire Management Officer through November 2012
- Ed Spence, District Timber Management Assistant
- Dr. Martin Spetich, Research Forest Ecologist, Southern Research Station
- Brian Sullivan, Assistant District Fire Management Officer/Acting Fire Management Officer
- J. Swafford, District Other Resources Assistant
- Gregg Vickers, Forest Silviculturist and Pesticide Use Coordinator
- Jessica Wakefield, District Wildlife Biologist
- Amanda Walrod, District Civil Engineering Technician
- Len Weeks, Forest Soils Scientist
- James K. Whalen, Forest Fisheries Biologist

Contributing Forest Service Specialists and Personnel:

- Jeremy Evans, Cartographic Technician
- Tamara Hocut, Forest GIS Coordinator
- Ronald P. Hotard, Forestry Technician (retired 2012)
- Terry Krasko, Forest Planning Staff Officer
- Lauren Marshall, USDA Forest Service Washington Office Forest Management Staff, Landscape Architect
- David Meriwether, Region 8, Regional Office, Ecosystem Management Coordinator
- Tina Rotenbury, Forest GIS Specialist
- Craig Rudolf, Research Ecologist, Southern Research Station
- Ron Krupka, Ouachita National Forest Landscape Architect (retired 2011)

Consulting Forest Service Specialists:

- Jim A. McDonald, Environmental Coordinator, Region 9, Regional Office
- Jody Sutton, NEPA Specialist, National Forest Service, Washington Office, Ecosystem Management Coordination
- David Seesholtz, Research Liason, Region 6, Regional Office
- David Harris, Regional NEPA Coordinator, Region 8, Regional Office
- Rebecca Bartol, Forester, Region9, Superior National Forest, Gunflint and Tofte Ranger Districts
- Katie Van-Alstyne, Natural Resource Planner, Region 2, Black Hills National Forest, Mystic Ranger District
- Vincent Vukelich, Office of General Council

Scoping Lists

The following were mailed scoping notices on March 8, 2012:

Native American Tribes

- The Honorable George Blanchard, Governor, Absentee Shawnee Tribe of Indians of Oklahoma
- Ms. Henryetta Ellis, THPO, Absentee Shawnee Tribe of Indians of Oklahoma
- Ms. Lisa Botone, Cultural Preservation Assistant, Absentee Shawnee Tribe of Indians of Oklahoma
- The Honorable Tarpee Yargee, Chief, Alabama-Quassarte Tribe of Oklahoma
- The Honorable Augustine Asbury, Second Chief, Alabama-Quassarte Tribe of Oklahoma
- The Honorable Brenda Shemayme-Edwards, Chairperson, Caddo Nation
- Mr. Bobby Gonzalez, NAGPRA Coordinator, Caddo Nation
- Mr. Robert Cast, THPO, Caddo Nation
- The Honorable Bill Baker, Principal Chief, Cherokee Nation
- Dr. Richard Allen, Ed.D, Policy Analyst, Cherokee Nation
- Ms. LaDonna Brown, Historic Preservation Officer, Chickasaw Nation
- Dr. Ian Thompson, Director, Historic Preservation Department, Choctaw Nation
- The Honorable Kevin Sickey, Chairperson, Coushatta Tribe of Louisiana
- The Honorable Kerry Holton, President, Delaware Nation
- Ms. Tamara Francis Four-killer, NAGPRA/Cultural Preservation Director, Delaware Nation
- Ms. Ivy Smith, Cultural Preservation Assistant, Delaware Nation
- Mr. Jason Ross, Section 106 Assistant, Delaware Nation
- The Honorable Glenna Wallace, Chief, Eastern Shawnee Tribe of Oklahoma
- Ms. Robin Dushane, Cultural Preservation Director, Eastern Shawnee Tribe of Oklahoma

- Honorable Mekko Tiger Hobia, Kialegee Tribal Town
- The Honorable Thomas Gamble, Chief, Miami Tribe of Oklahoma
- Mr. George Strack, THPO, Miami Tribe of Oklahoma
- Mr. Scott Willard, THPO Administrative Assistant, Miami Tribe of Oklahoma
- The Honorable George Tiger, Principal Chief, Muscogee (Creek) Nation
- Mr. Ted Isham, Cultural Preservation Manager, Muscogee (Creek) Nation
- Dr. Andrea Hunter, Tribal Historic Preservation Officer, Osage Nation
- The Honorable John P. Froman, Chief, Peoria Tribe of Oklahoma
- Mr. Frank Hecksher, Section 106/NAGPRA Representative, Peoria Tribe of Oklahoma
- The Honorable John Berrey, Chairman, Quapaw Tribe of Oklahoma
- Ms. Carrie Wilson, NAGPRA Coordinator, Quapaw Tribe of Oklahoma
- Ms. Jean Ann Lambert, THPO, Quapaw Tribe of Oklahoma
- The Honorable Leonard Harjo, Principal Chief, Seminole Nation of Oklahoma
- Ms. Natalie Deere, Historic Preservation Officer, Seminole Nation of Oklahoma
- The Honorable Ron Sparkman, Chairman, Shawnee Tribe
- Ms. Kim Jumper, THPO, Shawnee Tribe
- Honorable Mekko, George Scott, Thlopthlocco Tribal Town
- Ms. Barbara Canard-Wellborn, Advisor, Thlopthlocco Tribal Town
- The Honorable Earl J. Barbry Sr., Chairman, Tunica-Biloxi Tribe of Louisiana
- Mr. Earl J. Barbry Jr., Director, Tribal Museum and Cultural Resource Center, Tunica-Biloxi Tribe of Louisiana
- The Honorable George Wickliffe, Chief, United Keetoowah Band of Cherokee Indians
- Ms. Lisa LaRue, Historic Preservation Officer, United Keetoowah Band of Cherokee Indians
- The Honorable Cheryl Smith, Principal Chief, Jena Band of Choctaw Indians
- Ms. Dana Masters, THPO, Jena Band of Choctaw Indians
- The Honorable Leslie Standing, President, Wichita and Affiliated Tribes
- Ms. Breezy Prince, President's Assistant, Wichita and Affiliated Tribes
- Mr. Gary McAdams, Cultural Program Planner, Wichita and Affiliated Tribes
- Mr. Jarrod Prince, Transportation Planner, Wichita and Affiliated Tribes

Government Agencies

- James Boggs, Field Supervisor, US-DOI, Fish and Wildlife Service, Arkansas Field Office, Conway, AR
- Margaret Harney, Team Leader, US-DOI, Fish and Wildlife Service, Arkansas Field Office, Conway, AR

- Erin Leone, Endangered Species Biologist, US-DOI, Fish and Wildlife Service Arkansas Field Office, Conway, AR
- Brent Clark, District Conservationist, Natural Resources Conservation Service, Mountain View, AR
- Buster Bodenhamer, District Conservationist, Natural Resources Conservation Service, Mountain Home, AR
- Brad Carner, Assistant Chief of Wildlife Management, Arkansas Game and Fish Commission, Little Rock, AR
- Allen Cathey, Biologist, Arkansas Game and Fish Commission, Calico Rock, AR
- Ken Shirley, District Fisheries Biologist, Arkansas Game and Fish Commission, Mountain Home, AR
- Blake Sasse, Nongame Mammal Program Coordinator, Arkansas Game and Fish Commission, Little Rock, AR
- Chuck Bitting, Buffalo National River, Harrison, AR
- Cindy Osborne, Arkansas Natural Heritage Commission
- C. Theo Whitsell, Arkansas Natural Heritage Commission
- Mike Mowery, Stone County Forester, Arkansas Forestry Commission, Mountain View, AR
- Dwayne Pitts, Stone County Ranger, Arkansas Forestry Commission, Mountain View, AR
- Marty White, Baxter County Ranger, Arkansas Forestry Commission, Midway, AR
- Stephen Short, Baxter County Forester, Arkansas Forestry Commission, Midway, AR
- Frances McSwain, Deputy State Historic Preservation Officer, Little Rock, AR
- Stacey Avey, Stone County Judge, Mountain View, AR
- Joe Bodenhamer, Baxter County Judge, Mountain Home, AR
- Ron Sterling, Mayor of Mountain View, AR
- Barbara Wallace, Mayor of Fifty Six, AR
- Glenn Crymes, Stone County OEM, Mountain View, AR

<u>Organizations</u>

- Karen Westby, Audubon Arkansas
- Scott Simon, AR Director, The Nature Conservancy
- Douglas Zollner, The Nature Conservancy
- McRee Anderson, The Nature Conservancy
- Dennis Daniel, National Wild Turkey Federation
- Jim Hinkle, National Wild Turkey Federation
- Merlin C. Tuttle, Bat Conservation International

- Dave Waldien, Bat Conservation International
- Jim Bensman, Heartwood
- Robert Cross, President, The Ozark Society
- Newton County Wildlife Association
- Glenn Hooks, Sierra Club Regional Representative
- Tim Ernst, OHT Association
- Michael J. Budd, U of A Wildlife Society
- Lori Freeze, Stone County Leader
- Dennis Brannon, Stone County Citizen
- Shane McElroy, Stone County Farm Bureau
- Emma Suarez, Pacific Legal Foundation

Individuals on the District's Mailing List

- Shawn Porter
- Mark Tew and Linda Boulton
- Carla Boucher
- Jill Easton
- Michael E. Cartwright
- Jerry Moore
- Karen Tinkle
- Duane W. Woltjen
- James R. Crouch
- Jerry Curtis
- Jim Allen
- Randy Janowitz
- James Bibler
- Donald Ausborn
- Philip E. Hyatt
- Richard Hempel
- Jerry Lovenstein
- Tamara Long
- Hank Tilley
- Gene Dunaway

Private Landowners and Other Individuals

The names of private landowners, retired Forest Service Personnel and others who were mailed scoping information are available in the project planning record.

APPENDICES

A. Detailed Descriptions of Alternatives 2 and 3
B. Maps not Provided in the Body of the Environmental Assessment
C. Biological Evaluation and Regional Forester's Sensitive Listed Species Assessment
D. Soil
E. 2007 Ozark-St. Francis National Forests Herbicide Monitoring Plan
F. Key Regulated Pollutants and Their Significance in Smoke
G. Insects and Diseases Affecting Hardwood and Pine Species
H. USDA Forest Service National Forest System Data Recording Protocols and Requirements for Invasive Species Survey, Inventory and Treatment (2012)
I. Ozark-St. Francis National Forests Threat Decision Matrix for Non-native Invasive Plant Species
J. Procedures for Inadvertent Discovery of Human Remains and Burials
K. Scenic Integrity Level Descriptions and Scenic Stability Definitions
L. Fire Regime Condition Class
M. Cited Literature and References

Appendix A:

Detailed Descriptions of Alternatives 2 and 3

General Design Criteria Applicable to Alternatives 2 and 3

The proposed treatments would be implemented in accord with Ozark-St. Francis National Forests' Revised Land and Resource Management Plan (Forest Plan) requirements, all applicable laws and regulations and direction given by the US Fish and Wildlife Service regarding survey requirements and/or project implementation within the active period of the Indiana bat.

It is anticipated implementation would continue for approximately 12 years. Different treatments within many of the same units are likely to be conducted during the timeframe for this project, but not necessarily in the same year.

1. When an area to be entered is identified:
    a. Field examinations to determine existing condition and prescription needs will be scheduled and conducted. (See Items 3and 3a of 'General Design Criteria Applicable to Alternatives 2 and 3' below.)
    b. Baseline data for canopy closure and regeneration within the area will be collected. (See 'Adaptive Management Monitoring' in this appendix)
        i. Where desired conditions do not exist, treatments will be prescribed to move toward them; annual treatment limits will apply.
        ii. Where desired conditions already exist, treatments will be prescribed to maintain them; annual treatment limits will apply.
    c. The transportation system in the area will be assessed to determine which if any roads would require maintenance or reconstruction to facilitate extraction of timber.
        i. If the miles of road requiring work to facilitate the extraction of timber exceed the annual caps set for this project, additional National Environmental Policy Act analysis and approval would be required.
        ii. Prior to scheduling road work, historic roads and roads with Civilian Conservation Corps rock culverts and bridges must be evaluated for historical significance. Photographs must be submitted to the Arkansas Historic Preservation Program.
            1. If deemed eligible for the National Register of Historic Places, and they cannot be preserved in place, Arkansas Architectural Resources Forms must be filled out and accompanied with color and black and white photographs; prior to contracting for repair or removal.
    d. Surveys for non-native invasive plant infestations will be conducted; treatment areas will be prioritized and treatment will be initiated within annual limits as budgets allow (see 'Non-native Invasive Plant Treatments' in this appendix).
2. When planning the program of work for a year
    a. the extent to which management activities may be scheduled (within the implementation limits set) will depend upon
        i. The ability to commit funding or to secure formal agreements to monitor the effects of management actions on canopy closure and regeneration,

effectiveness of non-native invasive plant treatments as described under 'Adaptive Management Monitoring' in this appendix.

1. All monitoring may be contracted, conducted by Forest Service employees or conducted through formal agreements with other agencies or non-government organizations.

ii. Results of a sediment modeling analysis:

1. A sediment model analysis will be conducted to estimate the tons of sediment that would be produced within the appropriate 6th level watershed if the actions prescribed, previously approved actions and plans for action on private land (if they are known) are implemented.
2. If the sediment model outputs indicate the prescribed activities may cause an increased level of concern within the 6th level watershed, adjustments will be made to the planned program of work.

b. The District Wildlife Biologist will:

i. Determine if there are any changes to the threatened and endangered and/or the Regional Forester's (Region 8) sensitive species lists for the Ozark-St. Francis National Forests;
ii. Determine if additional surveys for listed species or species proposed for listing are needed;
iii. Determine if new information about any species on the threatened and endangered species lists for the Ozark-St. Francis National Forests comes to light that may change the determination of effect made in the Biological Evaluation completed for this project;
iv. Determine if completion of a new or Supplemental Biological Evaluation and subsequent review by the responsible Forest Service Officer are warranted.
v. Determine which areas will require mist netting or other surveys required by US Fish and Wildlife Service to determine presence or probable absence of Indiana bats before tree cutting or burning can occur during the active period.
vi. Identify the number and types of snags and/or other trees to be retained within harvest units.
vii. Identify any site specific measures to protect populations of federally listed or Regional Forester's Sensitive listed species.

c. The District or Forest Archaeologist will ensure that the following measures are implemented on historical properties for unevaluated, eligible for listing or listed on the National Register of Historic Places:

i. <u>Measure HP1: Site Avoidance During Project Implementation</u>

1. Avoidance of historic properties will require the protection from effects resulting from the undertaking. Effects will be avoided by establishing clearly defined site boundaries and buffers around archeological sites where activities that might result in ad adverse effect are planned.

2. Buffers will be of sufficient size to ensure that integrity of the characteristics and values which contribute to, or potentially contribute to, the properties' significance will not be affected.
3. Temporary roads, log landings, and skid trails will be routed away from historic properties.

ii. Measure HP2: Site Protection During Prescribed Burns

1. *Prescribed Fire Containment Lines*:
    a. Historic properties located along existing non-maintained woods roads used as prescribed fire containment lines will be protected by hand-clearing those sections that cross the sites.
    b. Although these roads are generally cleared of combustible debris using a small dozer, those sections crossing archeological sites will be cleared using leaf blowers and/or leaf rakes. There will be neither removal of soil, nor disturbance below the ground surface during prescribed fire containment line preparation.
    c. Historic properties and features located along proposed routes of mechanically-constructed prescribed fire containment lines where they do not now exist will be protected during future burns by hand clearing sections of line that cross the site rather than re-clearing using heavy equipment.
    d. Where these activities will take place outside stands not already surveyed, cultural resources surveys and regulatory consultation will be completed prior to project implementation. Protection measures, HP1, HP3 and HP4 will be applied prior to project implementation to protect historic properties.
2. *Burn Unit Interior:*
    a. Combustible elements at historic properties in burn unit interiors will be protected from damage during burns by removing excessive fuels from the feature vicinity and as necessary, by burning out around the feature prior to igniting the main burn, creating a fuel free zone.
    b. Burn out is accomplished by constructing a set of two hand lines around the feature, approximately 30 to 50 feet apart and then burning the area between the two lines while the burn is carefully monitored.
    c. Combustible features located in a burn unit will also be documented with digital photographs and/or field drawings prior to the burn.
    d. Historic properties containing above ground, non-combustible cultural features and exposed artifacts will be protected by removing fuel concentrations dense enough to

significantly alter the characteristics of those cultural resources.

e. No additional measures are proposed to significantly alter the characteristics that have been previously burned or that do not contain combustible elements or other above ground features and exposed artifacts as proposed prescribed burns will not be sufficiently intense to cause adverse effects to these features.

3. *Post-Burn Monitoring*:

a. Post-burn monitoring may be conducted at sites to assess actual and indirect effects of the burns on the sites against the expected effects. Tribal and State Historic Preservation Officer consultation will be carried out with respect to necessary mitigation for any sites that suffer unexpected damage during the burn or from indirect effects following the burn.

iii. <u>Measure HP3: Other Protection Measures</u>

1. If it is not feasible or desirable to avoid an historic property that may be harmed by a project activity (HP1) then the following steps will be taken:

a. In consultation with Federally-recognized Tribes and the Arkansas State Historic Preservation Officer (SHPO), any sited with undetermined National Register status site(s) will be evaluated against National Register of Historic Places significance criteria (36 Code of Federal Regulations 60.4) to determine its appropriate designation; and if already determined eligible or listed, appropriate mitigation measures. The mitigation may require subsurface site testing; and if so, a detailed research design describing the proposed data recovery methods will be submitted to Tribes and SHPO for comment prior to the implementation of mitigation measures.

b. In consultation with the Arkansas State Historic Preservation Officer, tribes and nations and with the Advisory Council on Historic Properties if required, mitigation measures will be developed to minimize the adverse effects on the site, so that a finding of No Adverse Effect results:

c. The agreed-upon mitigation measures will be implemented prior to initiation of activities having the potential to affect the site.

iv. <u>Measure HP4: Discovery of Cultural Resources During Project Implementation</u>:

1. Although cultural resources surveys were designed to locate all National Register of Historic Places eligible archeological sites and

components these may go undetected for a variety of reasons. Should unrecorded cultural resources be discovered activities that may be affected that activity will halt immediately;

a. The resource will be evaluated by an archaeologist and consultation will be initiated with the State Historic Preservation Officer, tribes and nations, and the Advisory Council on Historic Properties to determine appropriate actions for protecting the resource and mitigating adverse effects.
b. Project activities at that locale will not resume until the resource is adequately protected until agreed-upon mitigation measures are implemented with State Historic Preservation Officer approval.

2. If human remains are expected in a cave, rockshelter, or open air site, then no archeological excavations are permitted, and no ground disturbing activities are allowed.
    a. If human remains are inadvertently discovered, then all work shall immediately cease within 150 feet of said discovery and the protocols specified in Appendix J of the Environmental Assessment will apply.

d. The area planned for entry in the following year will be identified, and the process outlined under items 2 and 3 will be repeated for that area.

3. If field going Forest Service personnel, contractors or partners observe any bat entering or exiting a tree, he or she will record the tree location with a global positioning system unit; mark it as a potential roost tree, and notify the District Wildlife Biologist.
    a. The District Wildlife Biologist will evaluate the tree and if it is confirmed as an Indiana bat roost, a 100 foot radius no-cut buffer around the tree will be observed during the active period of this species.
4. "No Entry" signs will be posted to alert and inform visitors where treatments are being implemented.
5. If non-native invasive plant infestations are present in a treatment unit or at the unit's point of access, vehicles, equipment, shoes and clothing must be cleaned before going to another area where no non-native invasive plant infestations have been identified.
6. Within the Sylamore Experimental Forest (Compartment 102), all prescribed activities must be coordinated through and approved by the Research Forest Ecologist at the Southern Research Station in Hot Springs, AR.
7. Trees that must be removed for safety purposes, merchantable sized stems felled during mechanical treatments and incidental green trees that are removed to facilitate management activities (including the passage of machinery or other vehicles), may be included in timber sale volumes (when practical) or sold through the forest products removal permit system if they can be accessed for removal.
    a. Dead and down material within closed timber sale units, within 100 feet of roads, and stems felled during other treatments may be sold through the forest products removal permit system.

    b. Firewood collection areas may be established when harvest units are closed or noncommercial operations are completed.
    c. Slash or other woody debris may be removed for biomass.
8. Straight lines and geometric shapes are to be avoided in cut units. Edges of harvest units will be organically shaped and/or feathered where appropriate to avoid a shadowing effect in the cut unit and, where possible will be oriented to contours and existing vegetation patterns to blend with the existing landscape character as appropriate.(Region 8 Scenery Treatment Guide)
9. To minimize impacts to scenery along Maintenance Level 3, 4 or 5 roads and the following Maintenance Level 2 Roads: 1101A, 1103A, 1105D, 1105E, 1105F, 1108, 1113A, 1127, 1132, 1183, 1186A, 1187A, 91013B, 91014D, 91029A, 91058R, 91061V, 91073A, and 91080A the following measures should be implemented where possible given other site constraints:
    a. For harvest in areas with a Moderate, High or Very High Scenic Integrity Objective designation:
    b. Leave tree markings or unit boundary marking should be applied so they are not visible within 100 feet of these travel routes.
    c. Where terrain permits, log landings, roads and bladed skid trails should be located out of view to avoid bare mineral soil observation from these travel routes.
    d. Harvest units (or openings) in contiguous woodland should be spaced no closer than 1000 feet apart next to these travel routes.
    e. For any actions that produce slash or woody debris within areas with a High or Very High Scenic Integrity Objective designation:
    f. Slash caused by treatments should be removed, burned, chipped or lopped to within an average of 2 feet of the ground when visible within 100 feet on either side of these travel routes.
    g. Root wads and other unnecessary debris such as slash piles should be removed or placed out of sight within 150 feet of key viewing points such as scenic overlooks, heavily used trails and these travel routes.
    h. Where terrain allows, stumps should be cut to within 6 inches of the ground in the immediate foreground when visible from key viewing points such as scenic overlooks, heavily used trails and these travel routes.
10. For any actions that produce slash or woody debris within areas with areas with a moderate Scenic Integrity Objective designation:
    a. Slash should be treated to within an average of 4 feet of the ground when visible within 100 feet on either side of these travel routes.
    b. When activities are planned along open authorized trails, warning signs will be placed on all trail access points and along the trail where activities are planned or are occurring.
11. When activities that produce slash or woody debris are planned along open authorized trails:
    a. Slash should be treated within 100’ of the corridor at a frequency commensurate with the level of use at the time as determined by the District Recreation Program Manager.
    b. Schedule the work outside major recreation seasons if possible.

12. If a section of authorized trail is temporarily closed due to harvesting:
    a. Slash caused by treatment operations will be treated to an average of 4 feet from the ground within 100' of the corridor prior to finalizing harvest activities on the affected unit.
13. Using segments of designated forest trails and skid trails/haul roads should be avoided as much as possible, but if necessary to do so, trail cleanup and rehabilitation measures shall be specified.
    a. Trail tread will be cleared of all slash prior to reopening that section for public use.
14. Temporary road and/or skid trail crossing across designated authorized trails shall be kept to a minimum.
    a. If this use cannot be avoided, a plan must be developed to ensure proper clean-up and rehabilitation work will be completed after the sale unit is closed.
        i. The District Ranger must approve the plan and installation of the temporary road and/or skid trail.
        ii. Any crossing must be perpendicular to the trail.
15. Character trees and trees that define the trail corridor shall be retained unless removal is necessary for safety reasons.
16. Vegetation management actions shall not change trail alignment or increase trail width unless those actions are needed for safety reasons or to protect resources.

HERBICIDE USE

Design Criteria Applicable to Herbicide Use for Alternatives 2 and 3

1. Operations involving herbicide application will be conducted in compliance with Forest Plan standards for integrated pest management (Forest Plan pages 3-4 and 3-5), and karst management zones (Forest Plan page 3-7) and streamside management zone widths (Forest Plan standard FW81) and in accord with manufacturer's label direction.
2. Pesticide Use Proposals must be completed for all herbicide applications.
3. The herbicides proposed for use with this project are limited to commercial formulations of glyphosate, triclopyr (amine and ester formulations), and imazapyr—the common names of the active ingredient in commercial formulations.
    a. Imazapyr will only be used to treat certain non-native invasive plants as determined by the Forest Botanist.
4. Characteristics of these chemicals are discussed at length in their respective risk assessments; these documents along with their and accompanying worksheets are hereby incorporated by reference. They are available on the internet at www.fs.fed.us/foresthealth/pesticide/risk.shtml:
    a. SERA TR 052-22-03b and SERA TR-052-22-03a-App. Forest Health Protection. Glyphosate: Human Health and Ecological Risk Assessment Final Report and Appendices
    b. SERA TR 052-29-03a. Forest Health Protection. Imazapyr: Human Health and Ecological Risk Assessment Final Report.

    c. SERA TR 052-25-03a and SERA TR-052-25-03a-App. Forest Health Protection. Triclopyr: Human Health and Ecological Risk Assessment Final Report and Appendices.
5. Within streamside management zones or for areas within 100' of a standing body of water, herbicide use would be limited to treatment of non-native invasive plants with glyphosate or triclopyr amine formulations labeled for aquatic use. No surfactant would be added for treatments within streamside management zones.
6. Herbicide will not be applied within karst management zones.
7. Herbicide will be applied at or below the range of typical rates stated by the manufacturer's herbicide label.
    a. Labeled rates are examined in each of the respective risk assessments.
    b. Manufacturer's labeled rates will not be exceeded.
8. For non-native invasive plant treatments utilizing herbicide, application rates and methods will follow manufacturer label instructions. Forest Service General Technical Report SRS-62, *Nonnative Invasive Plants of Southern Forests: A Field Guide for Identification and Control* will also be referenced as new non-native invasive plants are found; this document is hereby incorporated by reference. It is available for viewing at the Sylamore Ranger District Office or on the internet at http://www.srs.fs.usda.gov/pubs/36915 .
9. Cut surface (cut stump, hack and squirt, frill, injection), basal bark or foliar application methods would be utilized.
10. Selective, cut surface applications would be utilized for the majority of herbicide treatments.
    a. A citrus-based surfactant may be added to increase herbicide effectiveness outside streamside management zones. The rate of surfactant use shall be in accord with the manufacturer's label.
11. For selective, cut surface applications:
    a. Targeted stems would be cut with hand tools or felled with chainsaws.
    b. A small amount of herbicide solution would be applied directly to the cambial area of each stump or to the cut on the targeted stem.
    c. Squirt bottles or backpack spray units using low spray pressure and nozzles that produce either large droplets or a stream will be used to reduce the potential for herbicide drift.
    d. Cut stump applications may not be utilized in the 1,922 acre portion of the project area currently managed as a Roadless Area, but hack and squirt, frill and injection cut surface methods may be used when treating non-native invasive plant infestations.
12. The basal bark application method is selective, non-contiguous treatment method involves girdling young stems of target vegetation with a mixture of herbicide and a vegetable oil carrier with a low pressure backpack sprayer.
    a. The basal bark application method is appropriate for use to treat non-native invasive plant infestations within the 1,922 acre portion of the project area currently managed as a Roadless Area.

13. Foliar applications are most likely to be utilized to treat non-native invasive plant infestations, but may also be used to treat competing shrubby vegetation during timber stand improvement, site preparation or wildlife stand improvement operations.
    a. Herbicide would be applied directly to the leaves and stems but would not be applied to the point of run-off.
    b. Either a low pressure backpack sprayer, or—for large infestations—tractor-drawn or vehicle mounted sprayers may be used.

    c. A citrus-based surfactant may be added to increase herbicide effectiveness outside streamside management zones.
        i. The rate of surfactant use shall be in accord with the manufacturer's label.
    d. The foliar application method is appropriate for use when treating non-native invasive plant infestations within the 1,922 acre portion of the project area currently managed as a Roadless Area.
14. Appropriately qualified Forest Service personnel shall oversee all aspects of herbicide application to ensure that proper mixing, application, and clean-up procedures are followed.
    a. Observations regarding the aspects of herbicide application shall be documented.
15. Herbicide will not be applied directly to the soil or to water, and it will not be applied aerially.
16. "No Entry" signs will remain posted for a minimum of 48 hours after herbicide applications are completed.
17. Treatment units will vary in size and will be separated by untreated areas.
18. Procedures outlined in the *Ozark-St. Francis National Forests' Herbicide Monitoring Plan for Water Quality* (2007) will be followed. This document is provided in Appendix E of this Environmental Assessment.

Additional Design Criteria for Herbicide Use Applicable to Alternative 2

19. Glyphosate will be used for the majority of applications.
20. The following rates would be used for the majority of timber sale improvement, site preparation and wildlife stand treatments:
    a. glyphosate 2.0# acid equivalents / acre
    b. triclopyr 1.0 # acid equivalents / acre
21. Where the cut stump application method is utilized for timber stand improvement or wildlife stand improvement operations, felled hardwood stems may be removed through forest products removal permits, but no sooner than 30 days following the herbicide application. (Forest Plan standard FW22)

COMMERCIAL TIMBER HARVEST

Design Criteria for Commercial Timber Harvest Applicable to Alternatives 2 and 3

Approximately 47,929 acres of National Forest System lands within the project area have potential to receive commercial harvest. This figure includes National Forest System lands

generally located within ¼ mile of an existing road with a sustained slope of less than 35 percent. Timber harvests will not be conducted within the District's Special Interest Areas (City Rock Bluff, Clifty Canyon, Sandstone Hollow).

1. No more than 3,500 acres/year of intermediate thinning, single tree, group selection, seedtree, seedtree with reserves, shelterwood, shelterwood with reserves, salvage or sanitation harvests combined would be planned (offered for sale).
2. Actions associated with timber extraction from treatment units would also be implemented if needed. These may include:
    a. Construction of log landings, skid trails, and temporary roads.
        i. Locations of these installations would be determined by topography in each sale area and shall be approved by the Forest Service prior to use.
        ii. These installations would be obliterated after a sale area is closed.
    b. Purchaser road maintenance (up to 15 miles/year total)
    c. Road reconstruction (up to 10 miles/year total)
3. Treatment of non-native invasive plant infestations may be initiated before a harvest unit is opened or may be implemented concurrently with the harvest activities.

Design Criteria for Regeneration Harvests Applicable to Alternative 3

4. Because herbicide would not be used for site preparation or timber stand improvement mechanical treatments and prescribed burning would be utilized to remove seed sources of woody species that compete with oak, hickory or Shortleaf pine regeneration before a regeneration harvest is implemented.
    a. If advanced natural regeneration is not sufficient to re-stock a stand within 5 years of completing a regeneration harvest, at least one site preparation burn will be conducted prior to commencing with the operation.
    b. If sufficient levels of natural regeneration are not attained within 3 years after a regeneration sale unit is closed, reforestation activities (site preparation and planting) will be implemented.
    c. Prescribed fire shall be excluded from the unit until the regeneration is a minimum of 2 ½ feet tall.
5. If advanced regeneration is sufficient to re-stock a stand and is a minimum of 8' tall, competing under- and mid-story vegetation will be mechanically cut followed by a prescribed burn within two growing seasons after the mechanical treatment.
    a. Prescribed burning treatments shall be continued every two or three years on average until competing vegetation is sufficiently controlled.
    b. Once competing vegetation is determined to be sufficiently controlled, the unit shall be thinned to the desired stocking density.

TIMBER STAND IMPROVEMENT AND SITE PREPARATION TREATMENTS

Design Criteria for Timber Stand Improvement and Site Preparation Treatments Applicable to Alternatives 2 and 3

Approximately 65,229 acres of National Forest System lands have potential to receive site preparation and/or timber stand improvement (release, pre-commercial thinning, non-commercial thinning, and control of understory vegetation) treatments.

This figure includes all National Forest Service System lands within the project area boundary except the 1,922 acre portion currently being managed as a Roadless Area.

Design Criteria for Timber Stand Improvement and Site Preparation Treatments Applicable to Alternative 2

1. No more than 2,000 acres/year of timber stand improvement and site preparation activities combined would be conducted.
2. Target vegetation for these treatments would be woody species (except federally or Regional Forester's sensitive listed species) that are competing with selected dominant and co-dominant stems or young regeneration.
3. Handtools, mechanical equipment, herbicide applications or prescribed burning may be used individually or in combination to conduct timber stand improvement and/or site preparation actions.
    a. Acres treated with prescribed fire or mechanical treatments will apply toward the annual implementation totals for those treatments.
4. The majority of herbicide applications for timber stand improvement and site preparation would be selective and non-contiguous utilizing a cut surface method and glyphosate herbicide. The basal bark application method or foliar applications could also be used for timber stand improvement and site preparation operations.
5. For herbicide treatments where visible within 100 feet along either side of Maintenance Level 3, 4 or 5 roads and the following Maintenance Level 2 Roads: 1101A, 1103A, 1105D, 1105E, 1105F, 1108, 1113A, 1127, 1132, 1183, 1186A, 1187A, 91013B, 91014D, 91029A, 91058R, 91061V, 91073A, and 91080A use the cut stump method so standing dead vegetation is not visible.
6. Burning for site preparation and timber stand improvement purposes will be conducted in either the dormant season or growing season.
    a. Depending on conditions and timing of events, site preparation and timber stand improvement I burning objectives may be accomplished simultaneously during other prescribed burning operations.

Design Criteria for Timber Stand Improvement and Site Preparation Treatments Applicable to Alternative 3

7. No more than 4,000 acres/year of timber stand improvement and site preparation activities combined would be conducted.
8. Handtools, mechanical equipment and/or prescribed burning may be used individually or in combination to implement these activities.
    a. Acres treated with prescribed fire or mechanical treatments will apply toward the annual implementation totals for those treatments.

9. Treatment units would be entered as needed to achieve the desired result for timber stand improvement and site preparation actions.
    a. Frequency of return will be determined by site conditions and management objectives.
10. Burning for site preparation and timber stand improvement purposes will be conducted in either the dormant season or growing season.
    a. Depending on conditions and timing of events, site preparation and timber stand improvement burning objectives may be accomplished simultaneously during other prescribed burning operations.

REFORESTATION (PLANTING)

Design Criteria for Reforestation for Alternatives 2 and 3

Approximately 64,387 acres of National Forest System lands within the project area have potential to receive reforestation treatments under this project. This figure includes the National Forest System lands within the project area boundary except the 1,922 acre portion currently being managed as a Roadless Area and areas managed as non-forest.

1. No more than 700 acres/year would be planted.
2. Seed from the District would be collected and grown in a nursery for reforestation purposes.
3. Stands dominated by hardwood will not be converted to pine stands and stands dominated by pine will not be converted to hardwood stands.
4. Twenty-five acres (25) dominated by Loblolly pine, a non-native forest type, would be reforested with Shortleaf pine if that area is regenerated.

PRESCRIBED BURNING

Design Criteria for Prescribed Burning for Alternatives 2 and 3

All National Forest Service System lands within the project area (approximately 67,151acres) may be treated with prescribed burning during the timeframe for this project.

1. An average of 15,000 acres/year for the duration of the project would be burned.
2. Prescribed burning operations may occur during either the dormant or growing season.
    a. The return interval and season for burning will depend on conditions, management objectives and monitoring results.
3. The National Forest Service lands of the project area have been divided into twenty-two (22) burn units ranging from 215 to 10, 081 acres using existing roads and natural features as unit boundary lines.
    a. These are shown on the Proposed Burn Unit Map in Appendix B of this Environmental Assessment.
4. A prescribed burn plan will be prepared for each burn unit.

    a. The burn plan will be designed with conditions that will maximize smoke dispersion and minimize smoke impacts.
    b. Each burn plan will
        i. Be reviewed by appropriate resource specialists to ensure site specific measures are in place to protect sensitive resource sites.
        ii. Include a public notification plan.
        iii. Smoke sensitive targets will be specifically identified for each burn unit in its respective prescribed burn plan.
            1. At a minimum, smoke sensitive targets will include endangered bat hibernacula, nearby communities, state highways, main roads and developed recreation areas
5. The Forest Service's smoke management policies outlined under FSM 5144 and the guidelines outlined in the Arkansas Smoke Management Program will be followed on all prescribed burns.
    a. The Smoke Management Program is incorporated by reference; it is available on the internet at http://forestry.arkansas.gov/Services/KidsTeachersEveryone/Documents/ArkansasVSMG.pdf .
6. Prior to ignition, a site-specific weather report called a "spot weather forecast", provided by the National Weather Service, will be obtained to ensure parameters for good smoke dispersion are met.
7. Prescribed burning operations will 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 impacts to smoke sensitive targets cannot be mitigated.
8. During an operation, atmospheric conditions, fire and smoke behavior will be monitored.
    a. If conditions fall out of prescription or smoke movement changes and could impact a smoke sensitive target
        i. Ignition patterns may be adjusted or firing may be terminated
        ii. Suppression actions may be initiated.
9. Streams, existing roads or other natural features may be used as prescribed fire containment lines. Prescribed fire containment lines constructed for previous burns may be re-opened if needed.
10. Where streams, roads or previously constructed prescribed fire containment lines are not already in place, hand-line will be constructed when possible, but mechanical construction of new prescribed fire containment lines may be required in some instances.
    a. Between 1.0 and 2.0 miles of new prescribed fire containment lines may be mechanically constructed per year except within the 1,922 acre portion of the project area currently managed as a Roadless area.
    b. As soon as possible after completion of a burning operation, prescribed fire containment lines will be seeded with a Forest approved seed mixture to help speed natural recovery processes and reduce the potential for erosion.
11. To limit the potential for a burn to escape or to facilitate safety of prescribed burn personnel, some snags 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.

MECHANICAL TREATMENTS

Design Criteria for Mechanical Treatments for Alternatives 2 and 3

Approximately 65,229 acres of National Forest System lands within the project area have a potential to receive mechanical treatments during the timeframe for this project. This figure includes all National Forest Service System lands within the project area boundary except the 1,922 acre portion currently being managed as a Roadless Area.

1. No more than 600 acres/year of mechanical treatments would be conducted under this project.
2. Mechanical treatments may include felling woody vegetation with chainsaws, a skid steer shredder or other similar equipment. Felled stems, limbs and brush may also be shredded or chipped.
3. When equipment is used in glade areas, it must have rubber tracks or tires; no metal tracked equipment is to be used.

WILDLIFE STAND IMPROVEMENT TREATMENTS

Design Criteria for Wildlife Stand Improvement Treatments for Alternative 2

Approximately 67,151 acres of National Forest System lands have potential to receive wildlife stand improvement treatments under Alternative 2.

Outside the 1,922 acre area currently managed as a Roadless Area, these treatments may include felling trees and/or woody stems, girdling trees to create snags; use of prescribed fire, and mulching. Trees exhibiting roost tree characteristics, den trees and trees that produce mast (hard and soft) would be favored as leave trees.

Within the 1,922 acre portion of the project area currently being managed as a Roadless Area, no wildlife stand improvement actions involving tree cutting may be implemented.

1. No more than 2,000 acres/year of wildlife stand improvement activities would be conducted.
2. Handtools, mechanical equipment, herbicide applications or prescribed burning may be used individually or in combination to conduct wildlife stand improvement actions.
    a. Acres treated with prescribed fire or mechanical treatments will apply toward the annual implementation totals for those treatments.
3. The majority of herbicide applications for wildlife stand improvement actions will be selective and non-contiguous utilizing cut surface application methods and glyphosate herbicide. Basal bark or foliar applications may also be conducted.

4. For herbicide treatments where visible within 100 feet along either side of Maintenance Level 3, 4 or 5 roads and the following Maintenance Level 2 Roads: 1101A, 1103A, 1105D, 1105E, 1105F, 1108, 1113A, 1127, 1132, 1183, 1186A, 1187A, 91013B, 91014D, 91029A, 91058R, 91061V, 91073A, and 91080A use the cut stump method so standing dead vegetation is not visible.
5. Burning for wildlife stand improvement purposes will be conducted in either the dormant season or growing season.
    a. Depending on conditions and timing of events, wildlife stand improvement burning objectives may be accomplished simultaneously during other prescribed burning operations.

Design Criteria for Wildlife Stand Improvement Treatments for Alternative 3

Approximately 67,151 acres of National Forest System lands have potential to receive wildlife stand improvement treatments under Alternative 3.

Outside the 1,922 acre area currently managed as a Roadless Area, these treatments may include felling trees and/or woody stems with chainsaws, mechanically girdling trees to create snags; use of prescribed fire, and mulching. Trees exhibiting roost tree characteristics, den trees and trees that produce mast (hard and soft) would be favored as leave trees.

Within the 1,922 acre portion of the project area currently being managed as a Roadless Area, no wildlife stand improvement actions involving tree cutting or herbicide use may be used. Trees may be mechanically girdled to create snags and prescribed fire may be used.

1. No more than 4,000 acres/year of wildlife stand improvement activities combined would be conducted.
2. Handtools, mechanical equipment and/or prescribed burning may be used individually or in combination to implement these activities as needed to achieve the desired result in a treatment unit.
    a. Acres treated with prescribed fire or mechanical treatments will apply toward the annual implementation totals for those treatments.
3. Treatment units would be entered and treatments repeated as needed to achieve treatment objectives.
    a. Frequency of return will be determined by site conditions and management objectives.
4. Burning for wildlife stand improvement purposes may be conducted in either the dormant season or growing season.
    a. Depending on conditions and timing of events, wildlife stand improvement burning objectives may be accomplished simultaneously during other prescribed burning operations.

NON-NATIVE INVASIVE PLANT TREATMENTS

Design Criteria for Non-native Invasive Plant Treatments Applicable to Alternatives 2 and 3

1. Any terrestrial non-native invasive plant species on the National Forest System lands (approximately 67,151 acres) within the project area may be treated with herbicide except within Karst Management Zones.
2. No more than 1,100 acres/year of non-native invasive plant treatments with herbicide would be conducted under this project.
3. Within the 1,922 acre portion of the project area currently managed as a Roadless Area, non-native invasive plant treatments are limited to cut surface applications except cut stump, foliar and basal bark herbicide applications and prescribed burning.
4. Survey, treatment and monitoring of non-native invasive plant infestations shall be conducted in accord with *USDA Forest Service National Forest System Data Recording Protocols and Requirements for Invasive Species Survey, Inventory, and Treatment (April 2012).* This document is hereby incorporated by reference.
5. Treatment of non-native invasive plant infestations will be prioritized as per the Threat Decision Matrix in Appendix I. Areas with highest priority for treatment include roadways, riparian corridors and other areas where non-native invasive plant infestations have high potential to spread quickly.
    a. Non-native invasive plant infestations in high priority areas will be treated prior to or concurrently with implementation of ground disturbing treatments.
    b. If possible, the treatment should be implemented prior to seed development.
6. Repeated treatments over a period of years will likely be needed to control new growth, seedlings and re-sprouts.
7. Non-native invasive plant infestations in lower priority areas may be treated if
    a. the annual implementation cap for non-native invasive plant treatments has not been reached and
    b. the amount of herbicide to be applied per acre per year would not exceed manufacturer's label requirements.

ACTIONS TO PROTECT HIBERNACULA FROM HUMAN DISTURBANCE

Design Criteria for Actions to Protect Hibernacula from Human Disturbance Applicable to Alternatives 2 And 3

1. All known hibernacula (extant and historic use) will be evaluated to determine if gating and/ or fencing is needed.
    a. Evaluation shall consider if a hibernaculum is prone to flash flooding and/or if a cave gate is likely to alter air flow, temperature or other microclimate conditions.
2. Cave gate design would be developed and approved in coordination with the US Fish and Wildlife Service and the Arkansas Game and Fish Commission.
    a. To ensure cave gate design does not impede ingress or egress of the bats, cause injury to the bats, trap debris during flooding events or otherwise affect air flow

or other microclimate conditions, monitoring will be conducted before and after installation of any cave gate.

i. Pre and post cave gate installation monitoring protocols shall be developed in consultation with the US Fish and Wildlife Service and will be posted on the Ozark-St. Francis National Forests website when finalized.

b. To ensure tribal values are protected, the Osage Nation and any other Native American Tribe that wishes to be involved will be invited to participate in planning cave gate design and installation

ADAPTIVE MANAGEMENT MONITORING

The following apply to Alternatives 2 and 3.

Reporting and Monitoring Oversight

1. The District Ranger will assign duties of monitoring oversight and report preparation; monitoring reports will be posted to the OSFNFs webpage as follows:
    a. Beginning in fiscal year 2014, at least once annually, the District will report:
        i. The location, type and extent of management activities planned for the coming fiscal year
        ii. The location, type and extent of management activities implemented in the fiscal year including any changes to previously planned activities
        iii. Baseline data collected for canopy closure and regeneration
        iv. Pre and post gating assessments if a gate is installed (the location or name of the hibernaculum will not be disclosed).
        v. Herbicide monitoring results
2. On a 3 to 5 year interval, the District will report
    a. Effectiveness of treatment(s) on canopy closure, regeneration and non-native invasive plant infestations
    b. Management actions triggered by monitoring results

Canopy Closure

1. Canopy closure will be measured using a spherical densitometer; baseline and subsequent measurements shall be collected during the full leaf out period.
    a. A route will be identified through forested stand(s). Measurements will be taken at points on a set interval. The Forest Service Silviculture Handbook (FSH 2409.17, Chapter 8.1.7 Examination Travel Routes and 8.1.8 Number of Sample Points and Intervals) will be used to guide the interval at which points will be placed to take measurements.
    b. During the next full leaf out period after harvesting activities, prescribed burning operations or non-commercial treatments with potential to affect canopy closure are completed, canopy closure measurements will be taken.
    c. Results will be used to determine if treatments reduced canopy closure sufficiently to

i. meet percent optimal overstory density requirements outlined in the Forest Plan for the Indiana bat,
    1. If canopy closure has not been reduced sufficiently to meet percent optimal overstory density requirements outlined in the Forest Plan, one of the following options will be followed depending on the site's conditions:
        a. Return to the same area and thin to the desired level.
        b. Return to the same area and burn/thin again.
        c. Use option a or b above the next time a treatment is scheduled.
    2. Prescriptions for the next area to be entered will be adjusted accordingly.
ii. improve conditions to establish and support regeneration of roost tree species for the future.

Regeneration

1. Baseline data for regeneration will be collected during stand examinations.
2. Regeneration will be monitored as discussed in the Forest Plan under Forest-wide standard, FW11 which provides direction on stocking levels for both hardwood and pine stands.
3. Where criteria for regeneration harvests are met or where natural disturbance events have created openings, 0.01 acre sample plots will be taken to determine if regeneration is present and if it is what is needed to ensure species composition is sustained for the future.
4. Once regeneration is established, survival checks will be completed the 1st and 3rd years to determine the stocking levels of the stand.
5. If the stocking density falls below the lower level of the stocking guide in the Forest Plan then the area of regeneration will need to be inter-planted with either oaks or Shortleaf pine in order to meet the desired stocking level for the area.

Effectiveness of non-native invasive plant treatments

1. Monitoring to determine the effectiveness of non-native invasive plant treatments at controlling infestations in areas where canopy closure is opened and/or ground disturbing actions are implemented shall be conducted in accord with protocols outlined in *USDA Forest Service National Forest System Data Recording Protocols and Requirements for Invasive Species Survey, Inventory, and Treatment (April 2012).*
2. Post treatment evaluations will be made one to two months after herbicide is applied (or shortly after green up the following spring if the application was made near the end of the growing season.)
    a. If the majority of treated stems are not dead or do not appear to be affected, additional treatment with the same chemical or with one of the other herbicides selected for this project may be implemented if:

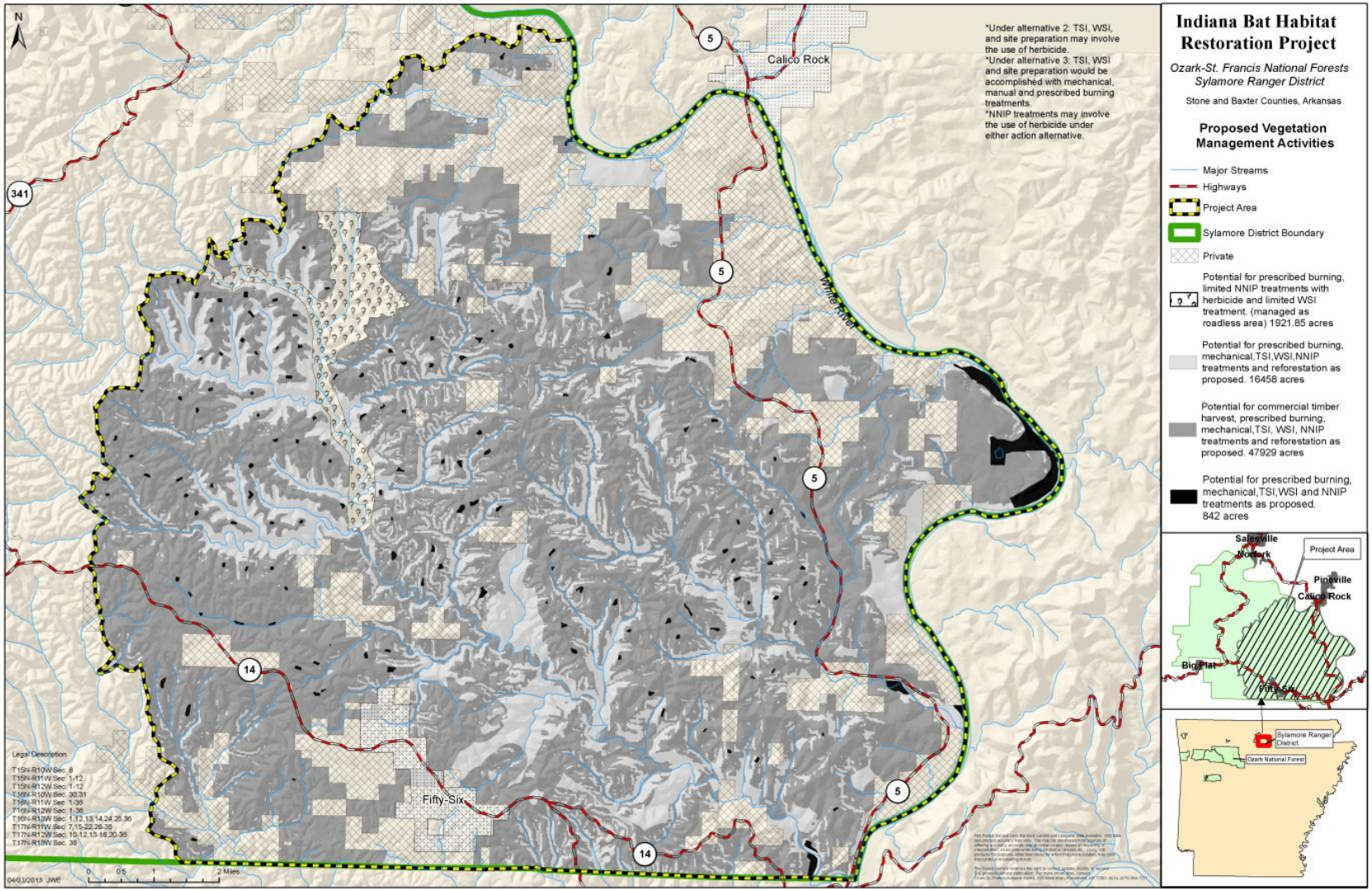
i. The annual implementation cap for non-native invasive plant treatments has not been reached, and
ii. The amount of herbicide to be applied would not exceed manufacturers' per acre per year label requirements.

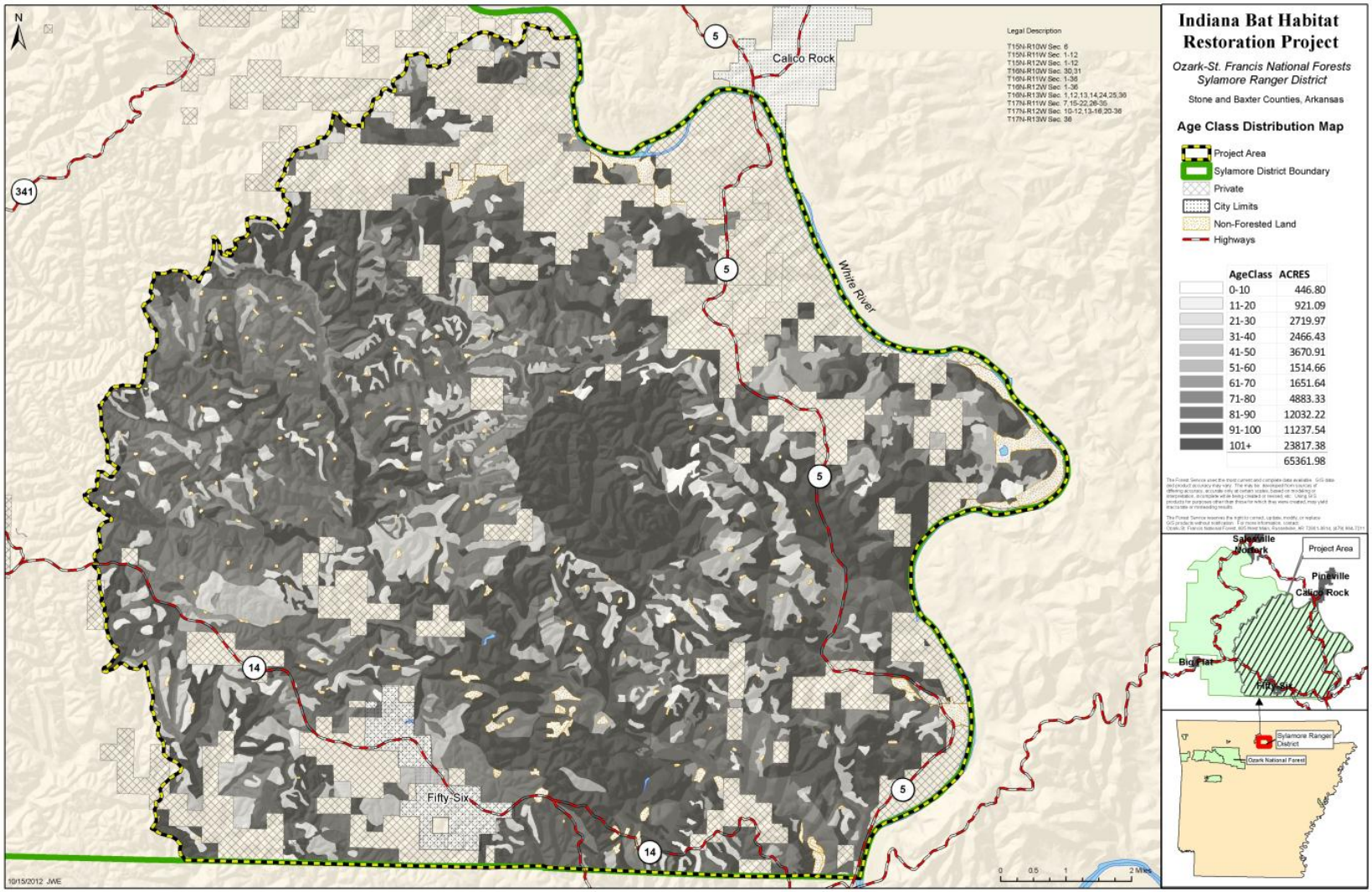
3. If all of the herbicides proposed for use do not adequately control a non-native invasive plant species, a new National Environmental Policy Act analysis will be initiated to examine other treatment options.

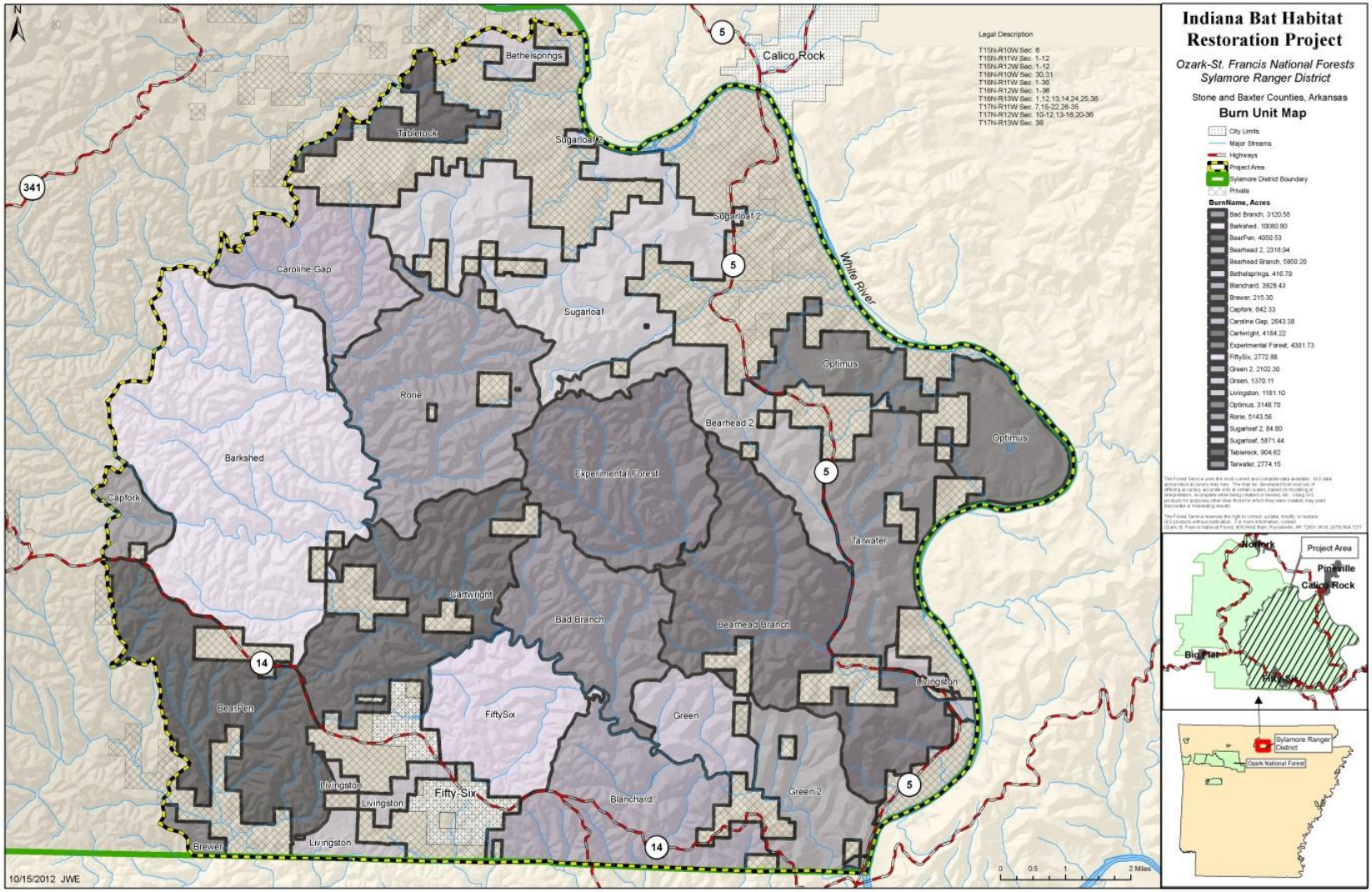
APPENDIX B:

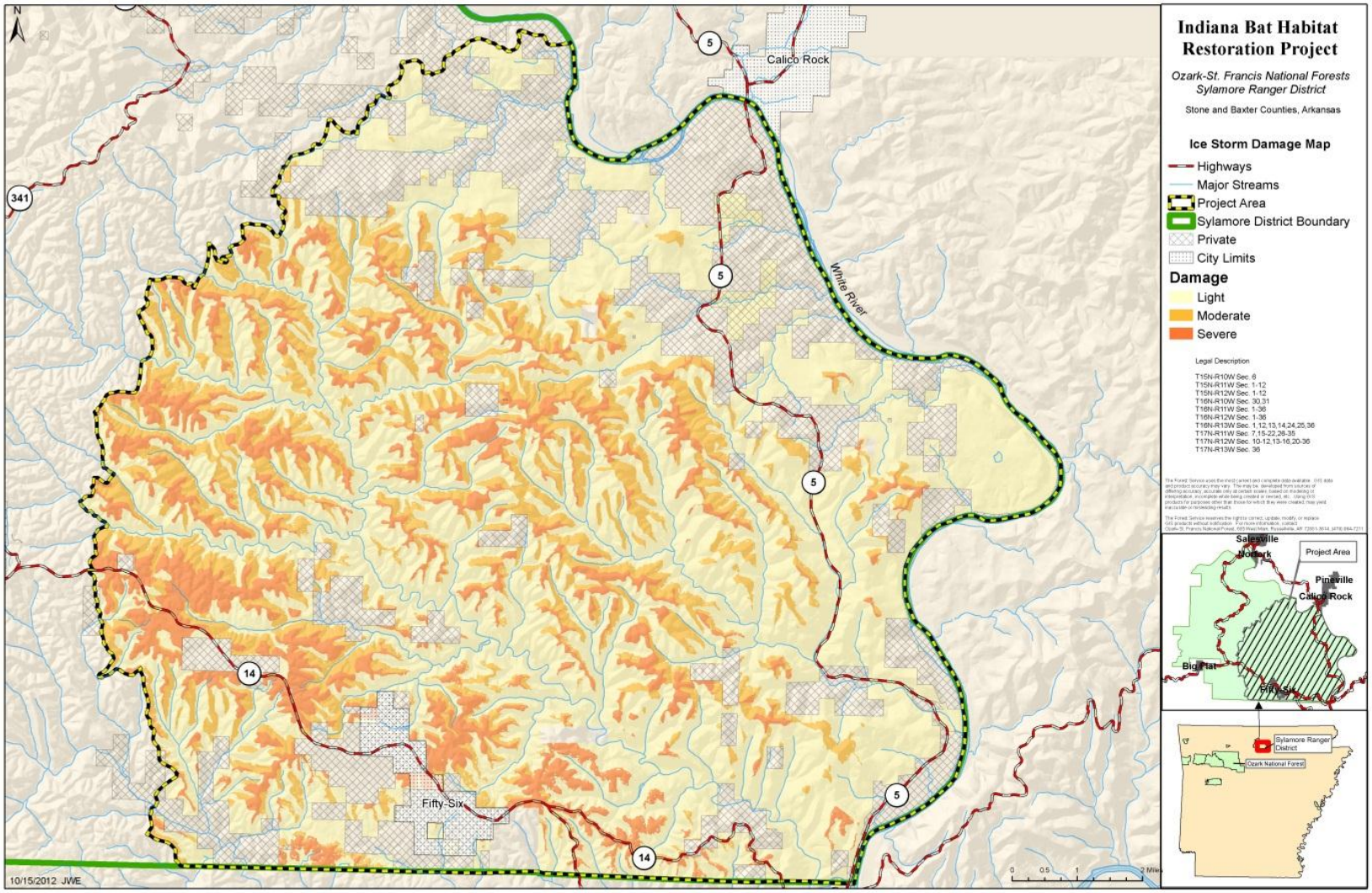
Maps not provided in the body of the Environmental Assessment

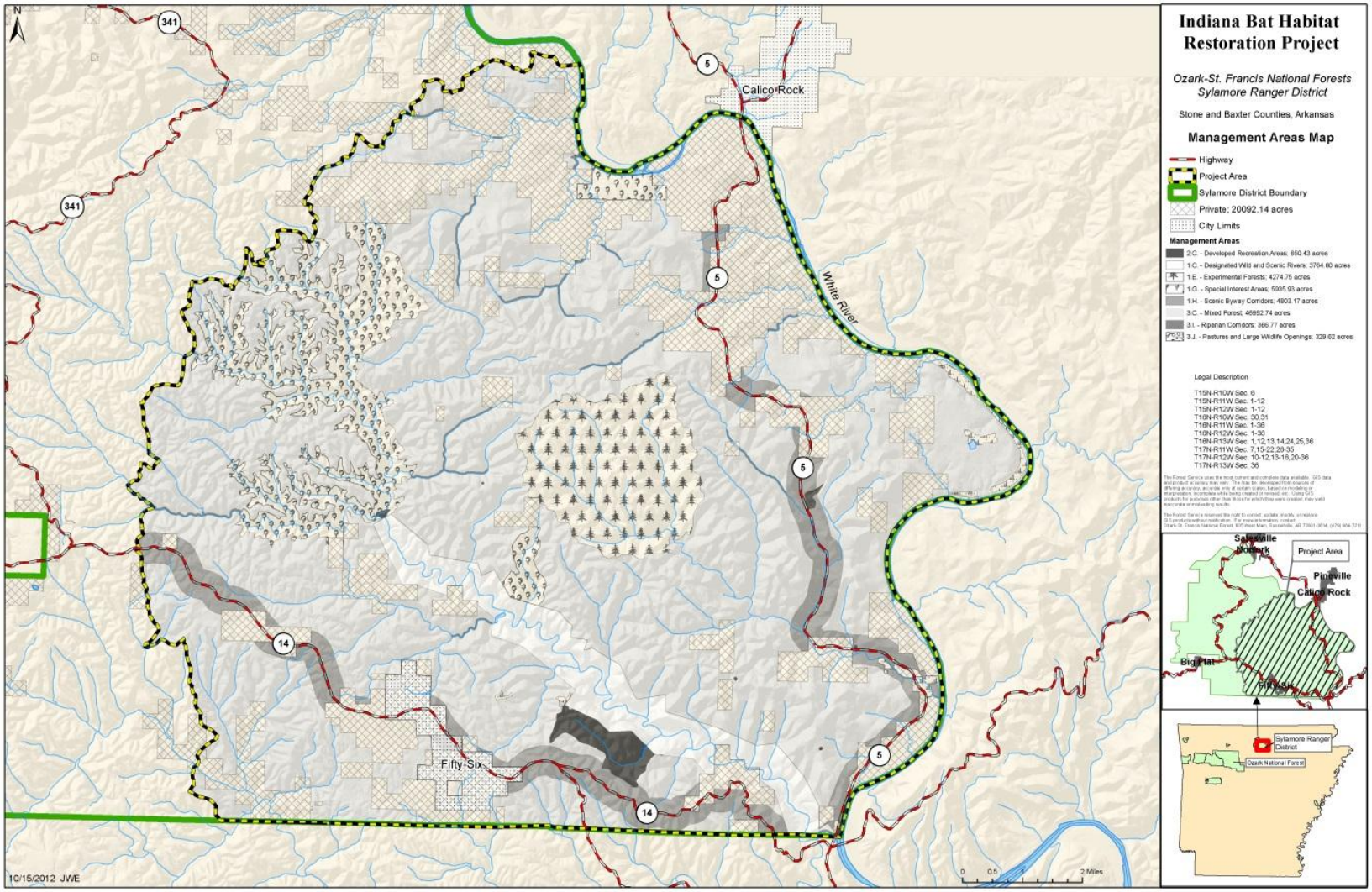
1. Proposed Vegetation Management Activities
2. Age Class Distribution of Forested Acres
3. Proposed Burn Units
4. Ice Storm Damage
5. Management Areas
6. Streams, Constructed Ponds, Lakes and Natural Ponds

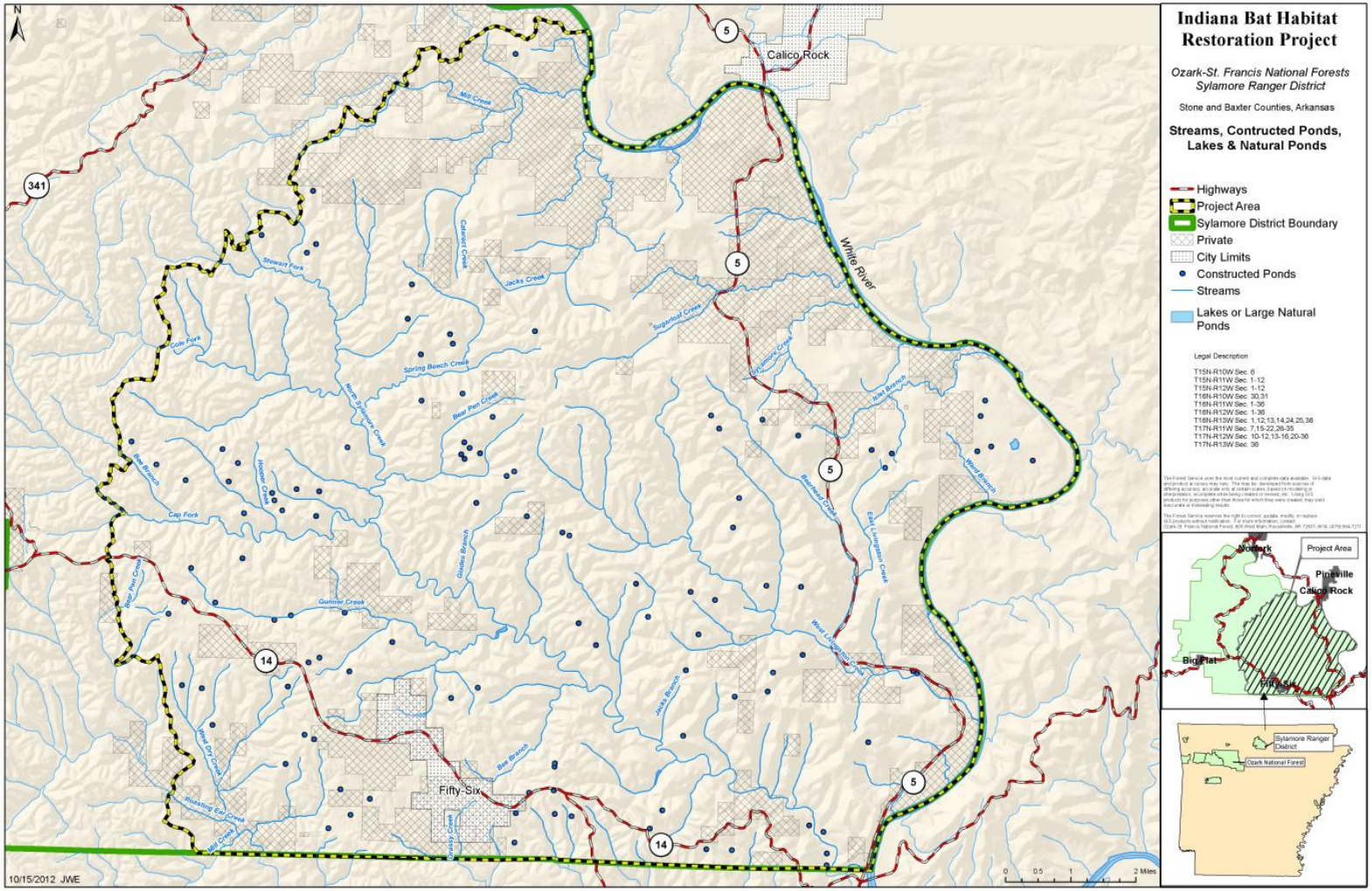

Indiana Bat Habitat Restoration Project
Ozark-St. Francis National Forests
Sylamore Ranger District
Stone and Baxter Counties, Arkansas
Proposed Vegetation Management Activities
Major Streams
Highways
Project Area
Sylamore District Boundary
Private
Potential for prescribed burning, limited NNIP treatments with herbicide and limited WSI treatment. (managed as roadless area) 1921.85 acres
Potential for prescribed burning, mechanical,TSI,WSI,NNIP treatments and reforestation as proposed. 16458 acres
Potential for commercial timber harvest, prescribed burning, mechanical,TSI, WSI, NNIP treatments and reforestation as proposed. 47929 acres
Potential for prescribed burning, mechanical,TSI,WSI and NNIP treatments as proposed. 842 acres
*Under alternative 2: TSI, WSI, and site preparation may involve the use of herbicide.
*Under alternative 3: TSI, WSI and site preparation would be accomplished with mechanical, manual and prescribed burning treatments.
*NNIP treatments may involve the use of herbicide under either action alternative.
Calico Rock
Fifty-Six
White River
341
5
14
Legal Description
T15N-R10W Sec. 8
T15N-R11W Sec. 1-12
T15N-R12W Sec. 1-12
T16N-R10W Sec. 30,31
T16N-R11W Sec. 1-36
T16N-R12W Sec. 1-36
T16N-R13W Sec. 1,12,13,14,24,25,36
T17N-R11W Sec. 7,15-22,28-35
T17N-R12W Sec. 10-12,13-16,20-35
T17N-R13W Sec. 36
0 0.5 1 2 Miles
04/03/2013 JWE
Salesville
Norfork
Project Area
Pineville
Calico Rock
Big Flat
Fifty-Six
Sylamore Ranger District
Ozark National Forest


Indiana Bat Habitat Restoration Project
Ozark-St. Francis National Forests
Sylamore Ranger District
Stone and Baxter Counties, Arkansas
Age Class Distribution Map
Project Area
Sylamore District Boundary
Private
City Limits
Non-Forested Land
Highways
AgeClass ACRES
0-10 446.80
11-20 921.09
21-30 2719.97
31-40 2466.43
41-50 3670.91
51-60 1514.66
61-70 1651.64
71-80 4883.33
81-90 12032.22
91-100 11237.54
101+ 23817.38
65361.98
Legal Description
T15N-R10W Sec. 6
T15N-R11W Sec. 1-12
T15N-R12W Sec. 1-12
T16N-R10W Sec. 30,31
T16N-R11W Sec. 1-36
T16N-R12W Sec. 1-36
T16N-R13W Sec. 1,12,13,14,24,25,36
T17N-R11W Sec. 7,15-22,26-35
T17N-R12W Sec. 10-12,13-16,20-36
T17N-R13W Sec. 36
Calico Rock
White River
Fifty-Six
Sylamore District Boundary
Project Area
Pineville
Calico Rock
Big Flat
Fifty-Six
Sylamore Ranger District
Ozark National Forest
N
341
5
14
0 0.5 1 2 Miles
10/15/2012 JWE


Indiana Bat Habitat Restoration Project
Ozark-St. Francis National Forests
Sylamore Ranger District
Stone and Baxter Counties, Arkansas
Burn Unit Map
City Limits
Major Streams
Highways
Project Area
Sylamore District Boundary
Private
BurnName, Acres
Bad Branch, 3120.58
Barkshed, 10080.80
BearPen, 4050.53
Bearhead 2, 2318.94
Bearhead Branch, 5850.20
Bethelsprings, 416.79
Blanchard, 3929.43
Brewer, 215.30
Capfork, 642.33
Caroline Gap, 2643.38
Cartwright, 4184.22
Experimental Forest, 4301.73
FiftySix, 2772.88
Green 2, 2102.38
Green, 1370.11
Livingston, 1181.10
Optimus, 3146.78
Rone, 5143.56
Sugarloaf 2, 84.80
Sugarloaf, 5871.44
Tablerock, 904.62
Tarwater, 2774.15
Legal Description
T15N-R10W Sec. 6
T15N-R11W Sec. 1-12
T15N-R12W Sec. 1-12
T16N-R10W Sec. 30,31
T16N-R11W Sec. 1-36
T16N-R12W Sec. 1-36
T16N-R13W Sec. 1,12,13,14,24,25,36
T17N-R11W Sec. 7,15-22,28-35
T17N-R12W Sec. 10-12,13-18,20-36
T17N-R13W Sec. 36
Calico Rock
Bethelsprings
Tablerock
Sugarloaf 2
Sugarloaf
White River
Caroline Gap
Rone
Barkshed
Capfork
Experimental Forest
Optimus
Bearhead 2
Tarwater
Cartwright
Bad Branch
Bearhead Branch
Livingston
BearPen
FiftySix
Green
Fifty-Six
Blanchard
Green 2
Brewer
Project Area
Pineville
Calico Rock
Big Flat
Sylamore Ranger District
Ozark National Forest
10/15/2012 JWE
0 0.5 1 2 Miles


Indiana Bat Habitat Restoration Project
Ozark-St. Francis National Forests
Sylamore Ranger District
Stone and Baxter Counties, Arkansas
Ice Storm Damage Map
Highways
Major Streams
Project Area
Sylamore District Boundary
Private
City Limits
Damage
Light
Moderate
Severe
Legal Description
T15N-R10W Sec. 6
T15N-R11W Sec. 1-12
T15N-R12W Sec. 1-12
T16N-R10W Sec. 30,31
T16N-R11W Sec. 1-36
T16N-R12W Sec. 1-36
T16N-R13W Sec. 1,12,13,14,24,25,36
T17N-R11W Sec. 7,15-22,28-35
T17N-R12W Sec. 10-12,13-16,20-36
T17N-R13W Sec. 36
Calico Rock
White River
Fifty-Six
Salesville
Mountain Home
Project Area
Pineville
Calico Rock
Big Flat
Fifty-Six
Sylamore Ranger District
Ozark National Forest
10/15/2012 JWE


Indiana Bat Habitat Restoration Project
Ozark-St. Francis National Forests
Sylamore Ranger District
Stone and Baxter Counties, Arkansas
Management Areas Map
Highway
Project Area
Sylamore District Boundary
Private; 20092.14 acres
City Limits
Management Areas
2.C. - Developed Recreation Areas: 850.43 acres
1.C. - Designated Wild and Scenic Rivers: 3764.60 acres
1.E. - Experimental Forests: 4274.75 acres
1.G. - Special Interest Areas: 5935.93 acres
1.H. - Scenic Byway Corridors: 4803.17 acres
3.C. - Mixed Forest: 46992.74 acres
3.I. - Riparian Corridors: 366.77 acres
3.J. - Pastures and Large Wildlife Openings: 329.62 acres
Legal Description
T15N-R10W Sec. 6
T15N-R11W Sec. 1-12
T15N-R12W Sec. 1-12
T16N-R10W Sec. 30,31
T16N-R11W Sec. 1-36
T16N-R12W Sec. 1-36
T16N-R13W Sec. 1,12,13,14,24,25,36
T17N-R11W Sec. 7,15-22,26-35
T17N-R12W Sec. 10-12,13-16,20-36
T17N-R13W Sec. 36
Project Area
Pineville
Calico Rock
Big Flat
Sylamore Ranger District
Ozark National Forest
Calico Rock
White River
Fifty Six
341
5
14
10/15/2012 JWE
0 0.5 1 2 Miles


Indiana Bat Habitat Restoration Project
Ozark-St. Francis National Forests
Sylamore Ranger District
Stone and Baxter Counties, Arkansas
Streams, Contructed Ponds, Lakes & Natural Ponds
Highways
Project Area
Sylamore District Boundary
Private
City Limits
Constructed Ponds
Streams
Lakes or Large Natural Ponds
Legal Description
T15N-R10W Sec. 6
T15N-R11W Sec. 1-12
T15N-R12W Sec. 1-12
T16N-R10W Sec. 30,31
T16N-R11W Sec. 1-36
T16N-R12W Sec. 1-36
T16N-R13W Sec. 1,12,13,14,24,25,36
T17N-R11W Sec. 7,15-22,26-35
T17N-R12W Sec. 10-12,13-16,20-36
T17N-R13W Sec. 36
Project Area
Pineville
Calico Rock
Big Flat
Sylamore Ranger District
Ozark National Forest
Calico Rock
Fifty-Six
White River
341
5
14
Mill Creek
Stewart Fork
Cole Fork
Cavern Creek
Jacks Creek
Sugarloaf Creek
Spring Bench Creek
North Sylamore Creek
Beal Pen Creek
Bear Branch
Cap Fork
Hoover Creek
Poor Pen Creek
Gunner Creek
Gibbs Branch
Beaver Creek
East Lampton Creek
West Lampton Creek
Jacks Branch
Bell Branch
West Dry Creek
Roaring Ear Creek
Mill Creek
West Creek
Weed Branch
0 0.5 1 2 Miles
10/15/2012 JWE

APPENDIX C:

Biological Evaluation and Regional Forester's Sensitive Listed Species Assessment for the Indiana Bat Habitat Restoration Project

BIOLOGICAL EVALUATION
FOR THE
INDIANA BAT HABITAT RESTORATION PROJECT

Sylamore Ranger District
Ozark-St. Francis National Forests
USDA Forest Service, Southern Region

Responsible Official:

James R. McCoy – District Ranger
Sylamore and St. Francis Ranger Districts
1001 East Main St.
Mountain View, AR 72560

Prepared by:

Jessica Wakefield – Zone Wildlife Biologist
Sylamore and St. Francis Ranger Districts
1001 East Main St.
Mountain View, AR 72560

TABLE OF CONTENTS

INTRODUCTION 2

ACTION AREA 8

SPECIES/CRITICAL HABITAT CONSIDERED 11

EFFECTS ANALYSIS 20

CONCLUSION AND DETERMINATION OF EFFECTS 30

LITERATURE CITED 33

APPENDIX 1 37

APPENDIX 2 39

The US Department of Agriculture (USDA) prohibits discrimination in all its programs and activities on the basis of race, color, national origin, sex, 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, 1400 Independence Avenue, SW, Washington, D.C. 20250-9410 or call 202-720-5964 (voice and TDD). USDA is an equal opportunity provider and employer.

Recycled Paper

INTRODUCTION

Objectives

Forest Service Manual (FSM) Section 2672.41 requires preparation of a biological evaluation (BE) and/or biological assessment (BA) for all Forest Service planned, funded, executed, or permitted programs and activities.
The objectives of this BE are to:

1) Comply with the requirements of the Endangered Species Act (ESA) of 1973 so that federal agencies do not jeopardize or adversely modify critical habitat (as defined in ESA) of federally listed species, and to document any need for consultation with the USDI Fish and Wildlife Service (USFWS).
2) Provide a process and standard to ensure that threatened (T) and endangered (E) species receive full consideration in the decision-making process for the Indiana Bat Habitat Restoration Project.
3) Assess effects associated with management actions to
    a. achieve or maintain percent canopy closure within optimal overstory density ranges for roosting and foraging habitat within the Indiana bat conservation zones;
    b. gate hibernacula, and
    c. create conditions that are likely to provide a continual supply of roost trees and foraging habitat.

Forest Service standards for the preparation of Biological Evaluations and Assessments, followed in the writing of this document, can be found in FSM Section 2672.42.

The Sylamore Ranger District (the District) supports known occurrences and suitable habitat for several T&E species, all of which are considered in this analysis. The USFWS has not identified any critical habitat or proposed critical habitat on the Ozark-St. Francis National Forests (OSFNFs) for any federally listed species or any species proposed for federal listing. This BE documents the analysis of the possible effects of management actions to known and potential populations and habitat of T&E plant and animal species within the area of influence of the project. This will also generate input for the environmental analysis of project-level decision-making to ensure compliance with the ESA, National Environmental Policy Act (NEPA), and National Forest Management Act (NFMA).

Background

Five extant Indiana bat hibernacula and one Indiana bat hibernaculum with historic use occur within a fairly concentrated area of the Ozark-St. Francis National Forests' Sylamore Ranger District. The locations of endangered bat hibernacula are protected under the Federal Caves Resources Protection Act. This document will be made available to the public; therefore, the locations and the names of

endangered bat hibernacula on the District will not be disclosed, but shall be referenced by an aphanumeric designation derived for the Indiana Bat Habitat Restoration Project. The key for the alphanumeric designations is in the project planning record.

The Indiana Bat Habitat Restoration Project is being proposed to meet commitments the Ozark-St. Francis National Forests made to the USFWS to manage habitat for the endangered Indiana bat. These commitments are identified as standards of the Ozark-St. Francis National Forests Revised Land and Resource Management Plan (Forest Plan). These standards are:

FW33: Maintain the following average standing dead, existing, and potential hollow den and loose bark trees per acre forest wide:

- Primary and Secondary Indiana Bat Zones – 9 snags per acre
- All other areas:
    - 2 snags per acre greater than 12" dbh; plus
    - 4 snags per acre
- Total 6 snags per acre

Unless necessary for insect/disease control or to provide for public safety, standing dead and den trees will not be cut during salvage operations.

Snags will be left from the largest size classes and may be clumped.

FW43: Karst management zones (KMZs) will be applied in a manner similar to that of streamside management zones (SMZs). Where karst features are identified, the boundaries of the KMZs will be delineated according to significance of karst features or potential risks. For karst features that are of significance or where the potential risks to water resources are great, a KMZ of 100 feet will be applied. For karst features that are less significant or where minimal potential risks to water resources exist, a KMZ of 50 feet will be applied. Karst management zones are mitigation measures primarily for the protection and conservation of groundwater resources and cave dependent species. These buffer designations are minimums and can be increased as necessary to provide appropriate mitigation measures as deemed necessary. Activities prohibited within these areas include:

- Use of motorized wheeled or tracked equipment (except on existing roads and trails).
- Mechanical site preparation
- Recreational site construction
- Tractor constructed fire lines for prescribed fire
- Herbicide application
- Construction of new roads, skid trails, and log landings
- Slash disposal

FW45: Within KMZs, there will be no mechanical entry during management activities; low impact vegetation management is appropriate.

FW47: Optimal overstory density within the primary zone around Indiana bat hibernacula is a range of 60 to 80 percent canopy closure. Use timber harvest, non-commercial thinning, and prescribed fire to regulate and maintain this optimal density.

During normal order of entry for compartments within Indiana bat primary conservation zones, do landscape scale analysis of existing forest stand conditions. This analysis should be used to determine commercial and non-commercial treatments needed to shift percent canopy closure toward the optimal overstory density. The long-term goal of treatments is to adjust canopy closure so that 80 to 90 percent of the primary conservation zone is within the 60 to 80 percent canopy closure range. This will not be fully accomplished during this planning period. Annually report canopy cover adjustments accomplished with commercial and non-commercial treatments within Indiana bat conservation zones to the Arkansas Field Office, USFWS.

When designating trees to be cut to regulate overstory density, two approaches are recommended for equating canopy density to target leave basal area. A simple rule of thumb is to use site index plus 10 as the target leave basal area. Another option is the use of canopy density/basal area conversion charts defined by tree diameter classes.

FW48: Optimal overstory density within the secondary zone around Indiana bat hibernacula is a range of 50 to 70 percent canopy closure. Use timber harvest, non-commercial thinning, and prescribed fire as needed to regulate and maintain this optimal density.

During normal order of entry for compartments within Indiana bat secondary conservation zones, do landscape scale analysis of existing forest stand conditions. This analysis should be used to determine commercial and non-commercial treatments needed to shift percent canopy closure toward the optimal overstory density. The long-term goal of treatments is to adjust canopy closure so that 80 to 90 percent of the secondary conservation zone is within the 50 to 70 percent canopy closure range. This will not be fully accomplished during this planning period. Annually report canopy cover adjustments accomplished with commercial and non-commercial treatments within Indiana bat conservation zones to the Arkansas Field Office, USFWS.

When designating trees to be cut to regulate overstory density, two approaches are recommended for equating canopy density to target leave basal area. A simple rule of thumb is to use site index plus 10 as the target leave basal area. Another option is the use of canopy density/basal area conversion charts defined by tree diameter classes.

FW52: Prescribed burn plans for areas containing caves or areas near significant caves or mines will identify these sites as smoke sensitive targets. The prescribed burn plans will be written to avoid active combustion and smoldering phase smoke from entering these sites when bats are present.

FW53: No commercial timber harvest may be used in KMZs up to 200 feet from cave entrances except for habitat protection or enhancement for threatened and endangered species.

FW54: Prohibit camping and campfires within 200 feet from the entrance to caves, mines and rock shelters used by TES species.

FW55: Close or restrict access to caves where disturbance or vandalism of critical resources may occur.

FW57: Identify caves or abandoned mines that contain significant populations of TES species as smoke-sensitive targets.

FW58: If significant bat roosting is found, these structures will be maintained or alternative roosts suitable for the species and colony size will be provided prior to adverse modification or destruction.

FW59: Do not issue permits for collection of TES species except for approved scientific purposes. Permits are also required from U.S. Fish and Wildlife Service and Arkansas Game and Fish Commission.

FW60: The use of caves for disposal sites or the alteration of cave entrances is prohibited except for the construction of cave gates or similar structures to ensure closure.

FW61: Before old buildings, wells, cisterns, and other man-made structures are structurally modified or demolished, they will be surveyed for bats. If significant bat roosting is found (TES species), these structures will be maintained or alternative roost sites for the species and colony size will be provided prior to adverse modification or destruction.

FW62: Watershed boundaries and recognizable landmarks such as roads, streams and bluff lines are used to identify primary and secondary conservation zones that extend out 0.25 (1/4) mile and 5 miles, respectively, surrounding Indiana bat hibernacula.

FW63: All known Indiana bat hibernacula should be evaluated for gates. If additional hibernacula are found, the caves should be evaluated for gating to protect Indiana bats during the critical hibernation period.

FW64: Project specific informal consultation will be done for all activities proposed within primary conservation zones. No disturbance that will result in the potential taking of an Indiana bat will occur.

FW65: In the primary conservation zone for the Indiana bat, the following new improvements and treatments are not permitted: permanent road construction, trails, grazing or hay allotments, wildlife openings, special uses, and integrated pest management using biological or species-specific controls. Other activities that create permanent openings are prohibited within the primary conservation zone.

FW66: Tree cutting and prescribed fires are prohibited in primary and secondary Indiana bat zones between May 1 and November 30. Adjustments to these dates may be made on a project-specific basis through coordination with the Arkansas Field Office, USFWS. Site-specific inventories are good for two calendar years from the date of survey completion.

FW67: Tree cutting and salvage operations can occur between December 1 and March 15 without a site-specific inventory. Additional coordination with USFWS is not required.

FW68: In the secondary zone buffer around Indiana bat hibernacula, a minimum of 60 percent of all forested acreage is maintained in nine inch or greater size classes. Of this total, about 40 percent will be trees in a mature condition. The 0 to 10 age class does not exceed 10 percent of the forested acreage of the secondary buffer at any time.

FW69: In the secondary zone buffer around Indiana bat hibernacula, live trees or snags, buildings, and other structures known to have been used as roosts by Indiana bats are protected from cutting and/or modification until they are no longer suitable as roost trees, unless their cutting or modification is needed to protect public or employee safety. Where roost tree cutting or modification is deemed necessary, it occurs only after consultation with the USFWS.

FW70: Shagbark hickory, because of its high value as roost/maternity sites, should receive special attention during sale layout and cultural treatments. In areas where shagbark hickory is uncommon, retain all shagbark hickory over six inches dbh (6” dbh) except those that are immediate hazards. If multiple 6-inch or greater stems are encountered, which are competing for moisture, nutrients, and growing space, thin to retain the largest shagbark trees with potential for crown development and longevity. Where shagbark hickory is common within the treatment stand and the surrounding landscape, retain the largest individual shagbark stems in the treatment stand as part of the 20 basal area (overstory) and allow smaller stems, which might be in excess of 6 inches dbh (6” dbh) to be removed during regeneration treatments.

The following documents are incorporated by reference: Revised Ozark-St. Francis National Forest Land and Resource Management Plan [(Forest Plan), USDA Forest Service 2005a], the Final Environmental Impact Statement (FEIS) for the Forest Plan (USDA Forest Service 2005b), and the SERA Human Health and Ecological Risk Assessments for Glyphosate, Imazapyr, and Triclopyr (USDA Forest Service 2011a,b,c respectively).

Summary of Developed Alternatives

Three alternatives have been developed for this project: a no action alternative (Alternative 1), the proposed action (Alternative 2) and a reduced herbicide alternative (Alternative 3).

Alternative 2 and Alternative 3 are adaptive management alternatives. They were designed to comply with all applicable federal, state, and local laws and regulations as well as Forest Plan requirements. They respond to the priorities, objectives and standards outlined in the Forest Plan to manage habitat for the endangered Indiana bat. The proposed activities are also consistent with other Forest Plan objectives including but not limited to improving forest health, improving habitat for other native plant and wildlife species, enhancing rare communities such as glades and canebrakes, reducing non-native invasive plant species, and reducing hazardous fuel loads.

No actions are being proposed on privately owned land. Summaries for the three alternatives follow. More detailed descriptions of actions proposed are outlined in the Environmental Assessment for the Indiana Bat Habitat Restoration Project.

Alternative 1 - No Action

Under Alternative 1, none of the activities proposed under Alternatives 2 or 3 would be implemented. The condition of the project area will be influenced by previously approved management actions, natural processes and events, actions necessary to protect public safety and routine maintenance of developed recreation areas, administrative sites and roads.

Alternative 2 - Proposed Action

Under Alternative 2, treatments would be prescribed as stand examinations are completed or as monitoring results trigger pre-determined responses. Chemical herbicides would be used to implement timber stand improvement, site preparation, wildlife stand improvement and treatment of non-native invasive plant infestations. The chemical herbicides proposed for use are limited to glyphosate, triclopyr (amine and ester formulations), and imazapyr. The use of imazapyr would be limited to the treatment of some non-native invasive plant infestations. The following actions are proposed:

- Cave gates installed on and/or fencing installed around extant (currently used) hibernacula, historic hibernaculum if use resumes, and other caves if use as a hibernacula is discovered.
- Commercial timber harvests (no more than 3,500 acres/year) and associated activities to extract timber which include

    - construction of temporary roads, log landings and skid trails where needed;
    - road reconstruction (no more than 10 miles/year), and
    - purchaser road maintenance (no more than 15 miles/year);
- Reforestation (no more than 700 acres/year);
- Site preparation and timber stand improvement activities (no more than 2,000 acres/year of mechanical, manual, chemical or burning treatments combined),
- Wildlife stand improvement activities (no more than 2,000 acres/year of mechanical, manual, chemical or burning treatments combined);
- Prescribed burning (an average of 15,000 acres/year)
    - No more than 2.0 miles total of new mechanically constructed prescribed fire containment line would be constructed per year.
    - Acres burned for all purposes will count toward the total number of acres burned per year.
- Mechanical treatments (no more than 600 acres/year);
- Treatment of non-native invasive plant species (no more than 1,100 acres/year with chemical herbicide);
- Annual programs of work and monitoring results will be posted on the Ozark-St. Francis National Forests' website.

If this alternative is selected, it is anticipated implementation would continue for approximately 12 years. Different treatments within many of the same units are likely to be conducted during the timeframe for this project, but not necessarily in the same year.

Alternative 3 - Reduced Herbicide Alternative

Under Alternative 3, gating or fencing hibernacula, harvest and associated actions to extract timber, prescribed burning and associated mechanical construction of prescribed fire containment line, mechanical treatments, treatment of non-native invasive plant infestations, monitoring and reporting would be as proposed for Alternative 2.

To accomplish timber stand improvement, site preparation and wildlife stand improvement work, only manual, mechanical and prescribed burning treatments would be utilized. Because these treatments typically remove only the above-ground portion of targeted stems, re-sprouting will occur; therefore, these treatments will need to be repeated until the desired results are realized. Annually, no more than 4,000 acres/year of timber stand improvement and site preparation and no more than 4,000 acres of wildlife stand improvement actions would be conducted.

If this alternative is selected, it is anticipated implementation would continue for approximately 12 years. Different treatments within many of the same units are likely to be conducted during the timeframe for this project, but not necessarily in the same year.

ACTION AREA

Area Description and General Location

The proposed project area reflects the portion of the secondary conservation zone for the Indiana bat on public lands managed by the Sylamore Ranger District. It is bordered by the White River on the northeast and east, the USFS Sylamore District proclamation boundary on the south, and prominent ridgelines just east of Highway 341 on the west and northwest. The project area is located within Stone and Baxter Counties of USGS quads Norfork Southeast, Norfork Dam South, Calico Rock, Boswell, Onia, Fifty-six, and Sylamore.

The geographic extent of the proposed project area includes approximately 87,243 acres within Stone and Baxter Counties, AR; of this total, approximately 67,151 acres are National Forest System lands and 20,092 are in private ownership. A map showing the vicinity of the proposed project area is attached.

Consultation History

Section 7 of the Endangered Species Act of 1973, as amended, outlines the procedures for interagency cooperation to conserve federally listed species and designated critical habitats. In 2005, the OSFNF prepared a Biological Assessment (BA) concerning the potential impacts of revision of the Revised Land and Resource Management Plan on endangered and threatened species. The standards and guidance of the revised Forest Plan that apply to federally listed species known to occur on the OSFNFs were developed through informal consultation with the US Fish and Wildlife Service (the Service). The BA determined the Forest Plan is "not likely to adversely affect" Bald eagle (which has since been delisted), Indiana bat, Ozark big-eared bat, Gray bat and Magazine Mountain shagreen; the BA also determined certain management activities within the defined American burying beetle area on the Ozark National Forest are "likely to adversely affect" that species. The BA was submitted for review to the US Fish and Wildlife Service (the Service) for review and formal consultation for the American burying beetle was requested. The Service provided concurrence with all the determinations of the BA in a letter dated August 17, 2005 and subsequently provided a Biological Opinion for the American burying beetle.

Since September 2005 informal consultation has been requested and received for numerous projects. Many have proposed similar management activities at a smaller geographic scale. Phone conversations with the US Fish and Wildlife Service employees occur on an "as needed" basis. Scoping notices are sent to the US Fish and Wildlife Service's Conway, AR Field Office for all projects requiring NEPA documentation.

In 2012, two species with occurrences in Arkansas (Yellowcheek darter and Ozark Hellbender) were listed as endangered. Neither has potential to occur on the Sylamore Range District.

This analysis complements an adaptive management project. As such, any alternative may be selected, and combinations of both may be selected for implementation. The determinations of effect for the action alternatives discussed here are the same. Alternative 3 is designed to produce the same desired condition as alternative 2 without the use of herbicides for timber stand improvement, site preparation and wildlife stand improvement actions. Both alternatives 2 and 3

comply with the standards and guidance outlined in the revised Forest Plan and are consistent with the actions for which the OSFNF received concurrence from the US Fish and Wildlife Service. Informal consultation with the US Fish and Wildlife Service is required for this project.

Reasonably Foreseeable Actions

Reasonably Foreseeable Actions on Adjacent Private Lands
The agency knows of no planned changes to existing private land uses in the vicinity of the analysis area. Because these lands have been in their current state for decades, it will be assumed they will remain in their current state for the next 12 years.

Most of the National Forest System lands within the proposed project area are in either a Fire Regime Condition Class 2 or 3; therefore, they are eligible to be burned for hazardous fuels reduction with Community Wildfire Protection Funds through cooperative (Stevens) agreements with the Arkansas Forestry Commission (AFC). The AFC would be in charge of conducting burns on private land. If accepted into this program, the landowners would receive this service at no cost; therefore, it is likely that this activity could occur during the timeframe for this project. Controlled burning of privately owned land is not being proposed by nor will it be conducted by the Forest Service. Entering into a cooperative agreement with the AFC is a voluntary action.

If either of the adaptive management alternatives is selected, the Forest Service may enter into cooperative agreements with willing landowners in the project area boundary to conduct any of the management actions proposed. Any actions conducted on private lands under such agreements would count toward the established annual implementation caps and would be subject to the same criteria for implementation.

Reasonably Foreseeable Actions on NFS Lands
Previously approved management actions within the Indiana Bat Habitat Restoration Project area include those of the *2009 Ice Storm Hazardous Fuels Reduction Project, the Rorie Project, the Sugarloaf Project, and the Utility Corridor Vegetation Management Project, the Kudzu Eradication Project, the Mare Hollow Project, Middleton Grazing Allotment #17, Landers Grazing Allotment #18, Dorsey Grazing Allotment #19, White River Grazing Allotment #20, Bonanza Grazing Allotment #21, and the Replacement of the Low-Water Crossings on North Sylamore Creek Accessing the Barkshed Recreation Area and the Upper Loop of the Blanchard Springs Recreation Area and of the Culverted Crossing Over Jack's Branch on the Sylamore Ranger District*. These projects were analyzed and approved under separate NEPA documents and are at various stages of completion. Previously approved activities under these projects include: commercial harvests, salvage cuts, site preparation, timber stand improvement work, use of herbicides, prescribed burning, mechanical treatments, grazing permits, hay cutting permits, wildlife habitat improvement work, non-native invasive plant treatments, road maintenance, replacement of low water crossings, culvert replacement, and road reconstruction.

Management actions necessary to protect public safety such as suppression of unplanned ignitions (wildfires), routine road maintenance and routine maintenance of developed recreation areas and administrative sites will also be implemented as needed.

SPECIES/CRITICAL HABITAT CONSIDERED

All federally Threatened and Endangered (T & E) species identified by the US Fish and Wildlife Service as occurring on or adjacent to the Ozark-St. Francis National Forests were considered in this BE.

Twenty listed species have been identified by the US Fish and Wildlife Service, Conway Office as occurring or having the potential to occur on the Ozark-St. Francis National Forests. These species are listed below in Table 1.

Table 1. Threatened and Endangered species identified by the US Fish and Wildlife Service as occurring or having the potential to occur on the Ozark-St. Francis National Forests. These species are considered in this BE.

Taxon	Scientific Name	Common Name	Status	Ozark NF Presence	Project Area Presence
Mammal	***Myotis grisescens***	**Gray Bat**	**E**	**1**	**1**
Mammal	***Myotis sodalis***	**Indiana Bat**	**E**	**1**	**1**
Mammal	***Corynorhinus townsendii ingens***	**Ozark Big-eared Bat**	**E**	**1**	**3**
Bird	*Sterna antillarum*	Interior Least Tern	E	3	-
Bird	*Campephilus principalis*	Ivory-billed Woodpecker	E	3	-
Reptile	*Alligator mississippiensis*	American Alligator	T	3	-
Amphibian	*Cryptobranchus alleganiensis bishopi*	Ozark Hellbender	E	3	3
Fish	*Amblyopsis rosae*	Ozark Cavefish	T	2	3
Fish	*Etheostoma moorei*	Yellowcheek darter	E	3	3
Fish	*Scaphirhynchus albus*	Pallid Sturgeon	E	3	-
Beetle	*Nicrophorus americanus*	American Burying Beetle	E	1	3
Crayfish	*Cambarus aculabrum*	Cave Crayfish	E	3	-
Crayfish	***Cambarus zophonastes***	**Hell Creek Cave Crayfish**	**E**	**2**	**3**
Mussel	*Potamilus capax*	Fat Pocketbook	T	3	-
Mussel	***Lampsilis abrupta***	**Pink Mucket**	**E**	**3**	**3**
Mussel	*Leptodea leptodon*	Scaleshell Mussel	E	3	-
Snail	*Inflectarius magazinensis*	Magazine Mountain Shagreen	T	1	3
Plant	***Physaria filiformis***	**Missouri Bladderpod**	**T**	**2**	**3**
Plant	*Lindera mellissifolia*	Pondberry	E	3	-
Plant	*Geocarpon minimum*	Geocarpon	T	3	-

Status Codes
"E" = species is listed as "Endangered" by the USFWS
"T" = species is listed as "Threatened" by the USFWS
"P" = species has been proposed for listing (as endangered or threatened) by the USFWS

Ozark NF Presence Codes
1 = Species is known to occur on the Ozark National Forest.
2 = Species is not known to occur on Ozark National Forest managed lands, but has suitable habitat within the Forest and a known distribution which makes occurrence possible.
3 = Species does not occur on Ozark National Forest managed lands and is not likely to occur there due to habitat requirements or geographic distribution.

Project Area Presence Codes
1 = Species is known to occur within the project area.

2 = Species is not currently known from the project area, but may occur there due to the presence of suitable habitat and a known distribution that makes occurrence possible.
3 = Species is not currently known from the project area and is not likely to occur there due to habitat requirements or geographic distribution.

Fourteen federally listed species from Table 1 above were eliminated from consideration for projects on the Sylamore District of the Ozark National Forest because they do not occur on the Forest or their known distribution is well outside the counties that make up the Sylamore Ranger District. These fourteen species include: interior least tern, ivory-billed woodpecker, American alligator, Ozark Hellbender, Ozark cavefish, yellowcheek darter, pallid sturgeon, American burying beetle, the cave crayfish *Cambarus aculabrum*, fat pocketbook, scaleshell mussel, Magazine Mountain shagreen, pondberry, and Geocarpon. The proposed action will have "**no effect**" on these species or their habitat and they will not be considered further in this BE. No further consultation with the US Fish and Wildlife Service for these species is required.

The remaining six federally listed species will be given further consideration in this document due to their known occurrence on the Sylamore Ranger District or their potential for occurrence due to the presence of suitable habitat on the District and records nearby. These species are indicated in **bold print** in Table 1.

Evaluated Species Information

The need to conduct site-specific inventories of T & E species for this project was assessed using direction in Forest Service Manual 2672.43. Based on this assessment, potential habitat in the proposed project area has either been inventoried for those T & E species whose range and habitat types may occur within the proposed project area, their presence in potentially suitable habitat has been evaluated for the purpose of this assessment, or it has been determined that the species cannot occur there due to lack or suitable habitat or limited range. Information about habitat distribution compiled in this BE, in addition to previous surveys done on the district, are sufficient to analyze the potential effects of this proposed project on the T & E species considered in this document. The conclusion that additional surveys are not required for each species listed in the tables above is based upon research literature sources where available (see Literature Cited section at the end of this document), and other specific observations. Some of these reasons include the following:

- The species is unlikely to occur because habitat is not present or the project area is outside the species' range.
- A current and adequate site-specific inventory for the species is already available.
- Survey methods are not feasible or effective.
- Even if the species is present, the project is expected to have "no effect" or "no impact" on the species (for example, because habitat within the project area where the species might occur will not be affected).
- The project is expected to have "beneficial impacts" without impacts to individuals that need to be mitigated (for example, the species is mobile enough to avoid short-term direct disturbance and long-term habitat will be improved, or the species is abundant enough based

on Forest-wide population information to be able to take some short-term losses of individuals in exchange for improved habitat and expected long-term population increases).

- Although adverse effects to habitat or impacts to individuals may occur, knowing numbers and location of individuals would not improve application of mitigation or assessment of the project's effects to viability.

Several sources were used to determine the federally listed T & E species that are known to occur or have the potential to occur within the proposed project area. These include Forest Service GIS data layers, the NatureServe website (www.natureserve.org), and records from field surveys conducted by Forest Service personnel and surveys conducted under contract or cooperative agreement by other individuals, agencies, or universities. GIS data layers were created from District field survey records and data obtained from the Arkansas Natural Heritage Commission (ANHC), 2010, the most current version available. The Rare Species Search engine provided by the ANHC's website (http://www.naturalheritage.com/research-data/rarespecies-search.aspx; accessed February 25, 2013) was used to augment the GIS data in determining the probable distribution of species.

The best available information on T & E species has been used to document this BE. Sources include data gathered during review of the scientific literature, review of surveys which have been conducted within or adjacent to the area but which have not been published, documented conversations with knowledgeable individuals in the academic, scientific, and resource management communities, and my best professional judgment in an effort to determine which T & E species occur or may occur within the proposed project areas. This discussion of effects upon T & E species and/or their habitats is needed to provide useful information to decision makers in selection of activities to accomplish goals and maintain wildlife, fish and plant populations and habitats. Understanding of species and their habitat requirements is based on District-specific surveys performed over the years. District-specific surveys used for this BE are listed in Appendix A of this BE.

Information on Species Which May Occur on the District

Individual species write-ups follow and include the most currently available information on range-wide and local distribution, habitat requirements and other information that can be used to determine the potential for direct, indirect, or cumulative effects to the species. Information sources used in this section include species write-ups and distribution information accessed from NatureServe (www.natureserve.org, accessed online January 7-February 25, 2013), the Arkansas Natural Heritage Commission website (www.naturalheritage.com, accessed online February 25, 2013), the Final Environmental Impact Statement for the Forest Plan (USDA Forest Service 2005b) and, the Ozark-St. Francis National Forest Biological Assessment and Biological Evaluation prepared for the Forest Plan. A list of other species specific documents and survey records can be found in the Literature Cited section of this document.

Gray bat

The gray bat population was estimated to be about 1.5 million in the early 1980s. At this time, the total population of the gray bat is estimated to be >1,000,000. Approximately 95% of the total population hibernate in only eight or nine caves primarily in Missouri, Arkansas, Kentucky, Tennessee and Alabama (NatureServe 2012).

Gray bats are cave residents throughout the year. Because of this, the greatest threats to the species are human entry into caves when bats are present and White-nose Syndrome (WNS). Gray bats are known to be susceptible to WNS. Different caves are usually occupied in winter than in summer, with the air temperature in caves being the greatest factor for use. During hibernation, gray bats are primarily found in deep vertical caves with large rooms that act as cold air traps (Harvey 1989). In summer months, female gray bats form maternity colonies in caves that, because of their configuration, trap warm air, or that provide restricted rooms or domed ceilings capable of trapping the combined body heat from clustered individuals. Information concerning WNS and bats can be found in Appendix 2 of this document.

Summer colonies are often found in large caves that contain streams usually located less than 1 km from rivers or reservoirs. They have rarely been found more than 2 km away from large water bodies. Each summer colony occupies a traditional home range that often contains several roosting caves scattered along as much as 70 km or river or lake shore.

Gray bats forage primarily over water along rivers or near lake shores, but individuals have been observed foraging along a pond on the Sylamore District (Whalen 2004). Most foraging occurs within 5 m of the surface. Wooded roads may be used as flight corridors between foraging and roosting areas.

Dr. Michael Harvey conducted studies on the distribution, status, and ecology of endangered Arkansas bats beginning in 1978 through his retirement in 2006. Following Dr. Harvey's retirement, the Arkansas Game and Fish Commission continued surveys within the state (Redman and Sasse 2006). The study was designed primarily to monitor populations of endangered bats at major Arkansas hibernacula and summer caves and to locate additional endangered bat colonies (Harvey 2006). Winter gray bat hibernacula are scattered over the north portion of the state, but the largest known hibernaculum in Arkansas (cave number C-24) is on the Sylamore Ranger District, where several hundred thousand bats gather to spend the winter. Summer roost sites are more scattered and can vary from one year to the next. In total, 11 caves on the District have evidence of historic use or are known to be used regularly by gray bats. Of these C-24 is the only Priority 1 cave; four (C-28, B, C-30, and C-29 caves) are Priority 2 caves. The remaining six caves receive intermittent or lower levels of use.

Mist netting surveys on the Sylamore Ranger District have been extensive; repeated, almost annual, and have been conducted since 2004 by Dr. Tom Risch and Arkansas State University. A variety of other surveys have also been performed (unpublished field studies and surveys on file at the Sylamore Ranger District Office). Regular cave surveys for the Gray bat on the Sylamore Ranger District began in 1984. Permanent monitoring caves have been established on the District and

Forest-wide. These sites are checked every two years to determine the species and estimate the number of endangered bats using these caves on the District.

Indiana bat

The Indiana bat was listed as endangered under provisions of the Endangered Species Act (ESA) on March 11, 1967 due to documented population losses and the species' vulnerability during hibernation when a high proportion of its population congregates in a small number of caves and mines. A Recovery Plan was developed by the U.S. Fish and Wildlife Service, dated October 14, 1983. This range-wide recovery plan identifies critical habitat, outlines distributional and life history information, makes management recommendations and lists recovery objectives. In October 1996, March 1998, and April 2007, the Indiana Bat Recovery Team released Technical Draft Indiana Bat Recovery Plans, with a five year review completed September 2009.

In general, decline of the species has been attributed to disturbing hibernating bat clusters in caves. About 85% of the total population hibernates in nine Priority 1 hibernacula; the remaining 15% have been or are currently distributed among 50+ Priority 2 and 3 hibernacula. Almost half of all Indiana bats hibernate in caves in southern Indiana (http://www.fws.gov/midwest/endangered/mammals/inba/index.html), accessed December 19, 2012). In all, about ninety wintering sites are known (NatureServe 2012). Indiana bats are easily awakened by any human activity such as cave vandalism, spelunker traffic, cave commercialization, and continuous scientific research (including over-collecting, too many trips to hibernacula, and banding in hibernacula). Threats to summer Indiana bat habitat, such as deforestation or pesticide use may also have impacts on the population. Recently, WNS has emerged as a significant threat to bats that hibernate in caves, and range-wide declines are a possibility. Information concerning WNS and bats can be found in Appendix 2 of this document.

Currently, the total global population is estimated to be about 424,708 individuals, with over 82% of these hibernating in Indiana, Kentucky, Illinois, and New York (http://www.fws.gov/midwest/endangered/mammals/inba/pdf/2011inbaPopEstimate04Jan12.pdf, accessed December 19, 2012). In Arkansas, the 2011 population was 1,206 or approximately 0.3% of the known range-wide population. Between 2001 and 2007, Indiana bat populations appeared to be increasing, reversing a previously declining trend. However, census data collected on hibernating colonies during the winter of 2009 to 2011 indicated an 18.5% decline. Indiana bats are known to be susceptible to WNS which has affected Indiana bat colonies and may have contributed to lower winter numbers (USFWS 2009). Within the species' range, the northeastern states of New Jersey, New York, and Vermont have suffered combined declines of over 60% within the last two years. Other states not known to be affected by WNS "also have declines, and biologists are looking for the possible cause" (http://whitenosesyndrome.org/, accessed August 27, 2012).

Less than one percent of caves within the range of this species are suitable for hibernation. Five extant hibernacula are located in a fairly concentrated area of the Sylamore District. All are protected with either gates or closure orders. There is no critical habitat (as defined in the ESA) for the Indiana bat on the Ozark-St. Francis National Forests or in Arkansas. Forest Plan standards are

designed to enhance summer roosting and foraging habitat and to protect Indiana bats utilizing summer habitat from incidental take during management actions should they be present within a treatment unit.

The Indiana bat's life history and habitat requirements, for both the active portion of the year and during hibernation, are well known and succinctly summarized by Menzel et al. (2001). When Indiana bats are not hibernating, they generally roost underneath the exfoliating bark of trees. Roost sites have been discovered in a variety of tree species, including those with loose bark while the tree is living, such as pignut and shagbark hickory, and trees which only develop plates of loose bark when the tree is damaged, dying, or dead, including red maple, shortleaf pine, and hemlock. Indiana bats have also been found roosting in the splinters of the snapped off trunk of a broken tree. Males tend to roost singly or in small groups, while females generally form maternity colonies of a dozen or several dozen adults and their young. Indiana bats (both males and females with young) switch roosts readily and probably select sites that are suitable for current weather conditions. Roosts in sunlight would be utilized more often on cooler days, while roosts in shade or partial shade would be utilized during hot summer days.

Mist netting surveys on the Sylamore Ranger District have been extensive (unpublished field studies and surveys on file at the Sylamore Ranger District Office). Regular surveys for the Indiana bat on the Sylamore Ranger District began in 1979 and have been conducted Forest-wide, including mist netting surveys specifically for the Indiana bat conducted almost annually since 2004 (Risch). Individual males have been captured near hibernacula in the summer (1 in 2007, 1 in 2010 and 2 in 2012) during mist netting surveys on the District. Female Indiana bats have never been captured during these mist netting surveys on the District. Permanent monitoring caves have been established on the District. Two nights of Anabat recording were conducted by Kathryn Furr in September 2006 at the upper loop of Blanchard Springs campground; no Indiana bats were recorded.

Maternity colonies have not been located on the Ozark-St. Francis NFs. A study published in 2011 (Brandebura, Pannkuk and Risch) located a maternity colony in the Black River Wildlife Management Area in Clay County. This serves as the most southwesterly maternity habitat of Indiana bats recorded and the only known maternity site in Arkansas. Other reported summer maternity roost sites close to the area have been north of the Ozark Mountains in Missouri and southern Iowa (Harvey 1989).

Ozark big-eared bat

The range of this bat includes only a few caves in northwestern and north-central Arkansas, south-western Missouri, and eastern Oklahoma. Because Ozark big-eared bats are so rare, little is known about their biology. The total population of this species is probably less than 2,000 individuals (Harvey 2003). In Arkansas, only six caves are presently known to be regularly inhabited by colonies of Ozark big-eared bats: 1 hibernation cave with 2 nearby maternity caves in north-central Arkansas and 1 hibernation cave with 2 nearby maternity caves in northwestern Arkansas. The total population in Arkansas is around 550 individuals, with approximately 1,400 individuals in

Oklahoma. They are no longer known to exist in Missouri (Harvey 2003). The Ozark big-eared bat was listed as endangered because of its small population size, reduced distribution, and vulnerability to human disturbance. Habitat loss and increased human disturbance at maternity caves and hibernacula are likely causes of the species' decline. Predation, reduced food supply, and disease may have some effect, but human disturbance at maternity and hibernation sites remains the major concern.

The Ozark big-eared bat is generally associated with caves, cliffs, and rock ledges in well-drained, oak-hickory forest. Maternity caves and hibernacula occur in a number of different surroundings, from large continuous blocks of forest, to smaller forested 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 the edges, the bat may benefit from a less cluttered environment, but cover is nearby and prey densities are high.

Like many other bats, Ozark big-eared bats return year after year to the same roost sites and generally do not migrate for long distances (Harvey et al. 2003).

The closest known site of Ozark big-eared bats is on National Park Service land near the Buffalo River. This area is near the western edge of the Sylamore Ranger District. The Sylamore Ranger District has potential habitat for this bat, especially on the west side of the District.

Extensive bluffline surveys by Bill Puckett, US Fish and Wildlife Service Biologist, (1998-2004) have occurred throughout the District and in the project area. He did not positively identify this species on the District, however in 2001 he noted individual bats in three western Searcy County caves which might have been *Corynorhinus townsendii ingens*. These caves were rechecked in 2008 by Bill Puckett and former wildlife biologist Kathryn Furr; no *C. t. ingens* or scat was seen. These caves are within the possible range of the species, although ANHC records (2010) indicate that this species is restricted to Marion and Washington Counties.

This species has not been documented in any mist netting surveys on the District (unpublished field surveys and reports filed at the District Office), or during surveys of permanent monitoring caves surveyed every two years.

It is not known whether or not Ozark big-eared bats are susceptible to WNS but it is likely due to the fact that they are a cave dwelling species. Information concerning WNS and bats can be found in Appendix 2 of this document.

Hell Creek Cave Crayfish

The Hell Creek Cave crayfish is known from only two caves in north-central Arkansas both located in Stone County. Its population is estimated at 50 to 250 individuals. The Arkansas Natural Heritage Commission and the Nature Conservancy purchased a 65 hectare tract that includes the cave's entrance. However, some of the lands near Hell Creek Cave are still in private ownership. A

new population of this species was discovered in 2006 in Nesbitt Spring Cave (Graening et al. 2006).

Hell Creek Cave and Nesbitt Spring Cave do not occur on or immediately adjacent to National Forest land, but the species does have the potential to occur in other caves in the area. The mapped passage for Hell Creek Cave is over one mile in length, and it could connect hydrologically to other caves. The underwater passages for Blanchard Springs Caverns have been searched and the Hell Creek Cave crayfish was not reported. However this was a one-time search and the species might have been overlooked.

Potential threats to this species include contamination or alteration in the flow of ground water. Actions on public lands around Hell Creek Cave have the potential to affect the existing known population. Karst protection measures outlined in the Forest Plan, however, should suffice to protect ground water quality from actions on Forest Service managed lands, if the Hell Creek Cave crayfish occurs on the District. NatureServe (2012) states the following recovery needs from the species' recovery plan "1) identify properties in the recharge area and protect these properties by agreement, zoning, proper sewage treatment, and other appropriate means; 2) survey caves to find additional populations and develop baseline population and water quality data."

Pink Mucket

The pink mucket is characterized as a large river species although in recent years it has been able to survive and reproduce in impoundments with river-lake conditions but never in standing pools of water (USFWS 1985). This species is found in waters with strong currents, rocky substrates, and depths up to about one meter as well as in deeper waters with slower currents with sand and gravel substrates.

This species is historically known from at least 25 river systems with a widespread distribution but was never collected in large numbers from any one site or drainage and was always considered rare (NatureServe 2012). The small populations can also cause problems with reproductive success and loss of genetic diversity. The pink mucket occurs in the lower Mississippi and Ohio Rivers and their larger tributaries. The largest population in Arkansas appears to be in the White River. This species is not found in streams or rivers on the Ozark and St. Francis National Forests. Arkansas Natural Heritage Commission (2007 data) reports occurrences in 27 counties across the state and that one specimen was collected from the North Fork of the White River near the town of Norfork. This is the closest known occurrence to the District; an additional population is known from at least 35 miles downstream. NatureServe (2012) states that populations west of the Mississippi River may represent an undescribed species. If they prove to be a different species, the conservation status will need to be reevaluated.

The greatest threats to pink mucket are from habitat loss due to dam construction, channelization and dredging. Populations may persist in reduced habitats, but their numbers may be lower (NatureServe 2012). Pollution, sedimentation, illegal harvesting, and introduction of the zebra mussel (through competition) also threaten this species. Recreational activity in on Sylamore Creek

and the White River near the Sylamore Ranger District could potentially lead to the further expansion of the zebra mussel.

Actions which affect the host fish species could be detrimental to reproductive success. For populations of pink mucket near the Forest, potential management influences include sedimentation, toxic chemicals, and altered flows. Forest-wide and riparian standards will protect the pink mucket and its habitat from sediment released and chemicals used during management activities.

Missouri bladderpod

Missouri bladderpod is generally found in the limestone glades of the Springfield Plateau area of four southwestern Missouri counties. The number of sites has greatly increased from the original nine known when the population was first listed in 1987. Currently there are sixty known sites, and although population size fluctuates greatly from year to year, in favorable years there have been half a million individuals reported. Managing sites with fire and mechanical removal of woody overstory is beneficial. In Arkansas, it is found in Garland, Izard, Sharp and Hot Spring Counties. The Hot Springs occurrence is a relatively recent discovery, located in the spring of 2005, and represents a significant range extension- 150 miles south of the nearest known site. It is also the first collection of the species outside the Ozark Mountains and on shale.

To date Missouri bladderpod has not been found on the Sylamore District despite surveys. No populations were found during recent glade assessments on the Sylamore District by The Nature Conservancy (Zollner 2011 to present). If it is found at a future date, managing glades with mechanical treatment and fire will improve and maintain habitat for this species.

EFFECTS ANALYSIS

No Action

Of the federally listed T & E species likely to occur on the Ozark National Forest (those listed in **bold print** in Table 1 on page 19), there are three bat species that would require cave gating proposed in the Indiana Bat Habitat Restoration project to protect them from harm. Human disturbance during hibernation for various reasons, including theft and vandalism, is a main cause for decline in these species. Cave gating will also help protect these bats from WNS by limiting human to bat transmission of the fungus *Geomyces destructans*. There will not likely be a continual supply of roost trees made available. Therefore, there will be a **likely to adversely affect** for the **Gray bat, Indiana bat, and Ozark big-eared bat** if no action is taken. The remaining three species would not require the proposed activities to protect them from harm if they occur here. Therefore, **Pink mucket, Missouri bladderpod and Hell Creek Cave crayfish** have a finding of **no effect**.

Alternative 2

The species reviewed will be grouped into habitat categories. The proposed management actions will be examined in light of how they may affect each habitat type and the species which are associated with it. The species-specific information provided above, such as habitat requirements, known distribution, or threats are considered. By relating the potential effects to habitats rather than just individual species, this analysis provides a broader look at the potential for effects. This can provide an opportunity to infer the potential for effects to more common species which are examined in other documents.

Bats, which may utilize many different types of habitats, will be discussed in a separate category. Species may be found in more than one habitat type, but will be discussed in the habitat that is most important or in which the species is most commonly found. These habitat categories will include riverine, rich woods, open or disturbed woods, glades and rocky outcrops, karst, and bats.

With respect to herbicide use, low rates of use, adherence to Forest Plan standards and label requirements, and established handling practices mitigate the potential for negative impacts. The cited risk assessments for glyphosate, triclopyr and imazapyr (USDA 2011a, b, and c respectively) indicate there is no plausible basis for asserting applications as proposed pose substantial risk.

Riverine Habitat and Associated Species

Pink mucket

Riverine habitat includes streams and rivers and the adjacent riparian zone along them. The species listed above is entirely or largely tied to these specific habitats. Named streams with portions within the Indiana Bat Habitat Restoration Project area include: Stewart Fork, Cataract Creek, Jack's Creek, Sugarloaf Creek, Cole Fork, N. Sylamore Creek, S. Sylamore Creek, Hooper Creek, Cap Fork, Gunner Creek, Bear Pen Creek, Glades Branch, Islet Branch, Ward Branch, Bearhead Creek, E. Livingston Creek, W. Livingston Creek, Jack's Branch, Bee Branch, Grassy Creek, Mill Creek, West Dry Creek, Spring Beech Creek and a small portion of Roasting Ear Creek. Surveys indicate that water does not flow within some of these streams year-round. The above listed species has never been located during field surveys of the area proposed for treatment.

The pink mucket has been recorded in the White River system, with the nearest collection made from the North Fork of the White River near the town of Norfork. This is the closest known occurrence to the District; an additional population is known from at least 35 miles downstream.

Prescribed burning is proposed for the entire Indiana Bat Habitat Restoration Project area. Prescribed burns are conducted under conditions that preserve ground cover and reduce the potential for sedimentation. Forest Plan standards will maintain stream quality during temporary road or fireline construction.

Established protocols such as transporting small amounts of herbicide (never more than that needed for one day), transporting herbicide in original containers, mixing herbicides away from water sources and at the site of application, and utilizing established containment and clean-up procedures

in the event of a spill will significantly reduce the possibility of accidental contamination of aquatic habitats.

The proposed project area is bordered by the White River on the east and northeast sides. Observance of streamside management zones (SMZs) will limit sediment contributions and will not alter the flow of the White River. Only herbicides approved for aquatic use will be used to treat non-native invasive plants infestations within the SMZ adjacent to the White River in which this species occurs. Therefore there will be **no effect** to the **pink mucket**.

Rich Woods Habitat and Associated Species

No threatened or endangered species are found in this habitat except possibly some of the bat species which are covered in their own category below. Rich woods habitat is characterized by high moisture levels and fertile, productive soils. Most frequently, this habitat occurs in drains, on lower slopes, or in bottomlands, but pockets may also exist around seeps and springs. General forest types within this group include mixed oak and oak-hickory, although pine can also be present. These conditions can be found in any age class, although species associated with this habitat type frequently benefit from some shade producing cover. On the Sylamore Ranger District, lower slopes along the streams and areas around springs or seeps appear to offer more moist and fertile soil than the surrounding ridgetops and glades.

Open or Disturbed Woods Habitat and Associated Species

No threatened or endangered species are found in this habitat except possibly some of the bat species which are covered in their own category below. Open woods can be present in a variety of conditions including small gaps in old growth forests, woods with interspersed grassland or disturbed woods. Examples of such areas can be rights-of-way (such as roads and utility corridors) wildlife openings, pastures, or areas cleared by natural disturbances. Species in this group may be associated with one or more of these natural or human-caused disturbances. Sites that could offer this type of habitat within the project area include road rights-of-way, glades, wildlife openings and range and hay allotments.

Glades and Rocky Outcrop Habitats and Associated Species

Missouri bladderpod

Rocky outcrops on the District generally occur as sandstone or limestone rock exposures. These outcrops can take several forms including exposed rock on the surface of the landscape, glades, talus slopes, and in their most striking forms, cliffs and bluffs. Some outcrops may be artificially created such as those that can occur along road cuts. The species included in this category are restricted to or show a preference for these habitats. Large glade areas and rocky outcrops along roadsides are present across the Sylamore Ranger District. Currently many of the glades have lost most of their characteristically open nature, and are being shaded out by encroaching trees. The above listed species has never been located during any field surveys in the Indiana Bat Habitat

Restoration Project area including glade assessments done by Doug Zollner from TNC (2011-present).

Observations of dormant season prescribed fires on the District indicate that glades and rocky outcrops do not carry fire well at that time of year; it is possible that fires will carry better and have a more beneficial effect on this habitat type when they are conducted in the growing season. Firelines may pass though glades; when they do, mist blowers may be used on the uneven and rocky terrain to prevent potential impacts from heavy equipment.

Requirements of Forest Plan standard FW28 will be observed to ensure herbicide applications will not affect known individuals or populations of Missouri bladderpod; therefore, it is not expected to be effected by these treatments.

Missouri bladderpod is not known from the District; therefore the project is considered to have **no effect** on this species.

Karst Habitat and Associated Species

Hell Creek Cave crayfish

Karst is a geological landform type created when limestone is dissolved by moving water. It is characterized by the presence of sinkholes, caves, and streams that disappear or resurge from underground, and springs where water resurfaces. Karst topography is complex and affects waterflow. Subsurface water movement may not follow surface drainage patterns. Karst areas could be potentially affected by pesticides, agricultural fertilizers, sewage systems, development, dumping, and excess sediment movement on the surface which could block sinks and karst windows, affecting water movement patterns below ground. Karst underlays the entire Sylamore Ranger District; caves and other karst features are wide-spread. Over 300 caves and 130 springs are known from the District and there is potential to find additional sites.

Karst habitats are difficult to survey because they are underground; passages can be dangerous, underwater, or too narrow to admit humans. It is also difficult to predict or discover if a known cave system connects to another system. Cave biota are frequently difficult to identify and may need to be removed and sent to specialists. Extensive cave inventories conducted between 2000 and 2002 identified over 230 species using 35 caves, including four species that were new to science. (Not all species discovered in caves, such as the black rat snake, require caves to live in.) A paper published by Graening et al. (2003) stated that a collector's curve indicated that additional species would likely be found with additional surveys.

The Hell Creek Cave crayfish has not been encountered on the Sylamore District, including surveys at Blanchard Springs Caverns, the largest known cave system on the District. The distribution of the Hell Creek Cave crayfish is not likely to expand based on the number of other cave systems within the potential range that have been searched without success. The recharge areas for known

cave populations do not extend on to Forest Service lands and populations in caves off of Forest Service lands are not being affected by activities on the Forest.

Forest Plan standards regarding restrictions within karst management zones will be implemented.

When considering the location of the proposed work in relation to the known and probable distribution of this species and the requirements to Forest Plan standards, this project will have **no effect** on the **Hell Creek Cave crayfish**.

BATS

Gray bat
Indiana Bat
Ozark big-eared bat

Bats are considered separately here because they are wide-ranging and are known to use a variety of habitats for roosting, feeding, and maternity and hibernation sites. They include all habitat classes already discussed. The gray bat uses many caves (both in summer and winter) across the District and forages over streams. Six of the District's caves are known Indiana bat hibernacula (5 extant and one historic).

Prescribed burning operations will follow Forest Plan standards, including identifying all hibernacula as smoke sensitive targets. Prescribed burning will be planned when conditions (such as wind direction and mixing height) make it unlikely that large levels of smoke will come near the caves. Ignition patterns may be adjusted to ensure smoke movement away from hibernacula. Atmospheric conditions will be monitored and weather reports reviewed during the burn. Firing will be terminated if changing conditions cause smoke movement that is likely to impact hibernacula.

In addition to the standards to protect caves used by rare bats, the Forest Plan includes standards for prescribed burning and timber management within the primary and secondary zones that will result in direct benefits for the Indiana bat. These include thinning stands to reduce canopy closure and using repeated prescribed burning to maintain these conditions. Reduced canopy closure will provide improved foraging and roosting opportunities for this species and increase the potential for establishment of regeneration. These Forest Plan standards are incorporated into the Indiana Bat Habitat Restoration Project.

Because actions involve the removal of larger diameter trees and creating smoke during burning, if these trees are occupied by Indiana bats at the time of felling or burning they could be disturbed or perish. Before burning or tree harvesting can occur during the active period of the Indiana bat (currently believed to be between March 15 and November 30) can be done, mist netting surveys will be conducted in accordance with guidelines established by the U.S. Fish and Wildlife Service to determine presence or probable absence of the species. The results of these surveys will be used to determine the time of year that the harvest or burns can take place in the surveyed area;

harvesting and burning will not be conducted during the active period if Indiana bats are found to use the surveyed area within that timeframe to protect them from harm. The results of these surveys will be good for two years, at which time they will be repeated if harvesting or prescribed burning is to be continued during the Indiana bat's active period.

In most cases, bats will readily move from one suitable roost tree to another if the tree is lost or disturbance occurs. Because all known hibernacula will be protected during prescribed burning and the proposed timber and prescribed burning actions will follow Forest Plan standards and may provide direct benefits for the **Indiana bat**, the species has a determination of **not likely to adversely affect**.

The remaining bat species use the general forest area during the spring, summer, and fall as flyways and for feeding, but utilize caves for roosting year-round. The occurrence of the Ozark big-eared bat on the District is uncertain, and if they occur, it is only likely on the western portion of the District in Searcy County. Therefore Ozark big-eared bats are not likely to be found in the proposed project area.

Forest Plan standard prohibits application of herbicide within karst management zones and restricts the use of equipment for activities such as during timber harvest or prescribed fire line construction. When considering these protective measures in relation to the gray bat and the Ozark big-eared bat, there will be **no effect** on the **gray bat** or the **Ozark big-eared bat**.

Effects of Alternative 3

The species reviewed will be grouped into habitat categories. The proposed management actions will be examined in light of how they may affect each habitat type and the species which are associated with it. The species-specific information provided above, such as habitat requirements, known distribution, or threats are considered. By relating the potential effects to habitats rather than just individual species, this analysis provides a broader look at the potential for effects. This can provide an opportunity to infer the potential for effects to more common species which are examined in other documents. Herbicides will not be used to accomplish TSI, site preparation and WSI work in this proposed management action.

Bats, which may utilize many different types of habitats, will be discussed in a separate category. Species may be found in more than one habitat type, but will be discussed in the habitat that is most important or in which the species is most commonly found. These habitat categories will include riverine, rich woods, open or disturbed woods, glades and rocky outcrops, karst, and bats.

With respect to herbicide use, low rates of use, adherence to Forest Plan standards and label requirements, and established handling practices mitigate the potential for negative impacts. The cited risk assessments for glyphosate, triclopyr and imazapyr (USDA 2011a, b, and c respectively) indicate there is no plausible basis for asserting applications as proposed pose substantial risk.

Riverine Habitat and Associated Species

Pink mucket

Riverine habitat includes streams and rivers and the adjacent riparian zone along them. The species listed above is entirely or largely tied to these specific habitats. Named streams with portions within the Indiana Bat Habitat Restoration Project area include: Stewart Fork, Cataract Creek, Jack's Creek, Sugarloaf Creek, Cole Fork, N. Sylamore Creek, S. Sylamore Creek, Hooper Creek, Cap Fork, Gunner Creek, Bear Pen Creek, Glades Branch, Islet Branch, Ward Branch, Bearhead Creek, E. Livingston Creek, W. Livingston Creek, Jack's Branch, Bee Branch, Grassy Creek, Mill Creek, West Dry Creek, Spring Beech Creek and a small portion of Roasting Ear Creek. Surveys indicate that water does not flow within some of these streams year-round. The above listed species has never been located during field surveys of the area proposed for treatment.

The pink mucket has been recorded in the White River system, with the nearest collection made from the North Fork of the White River near the town of Norfork. This is the closest known occurrence to the District; an additional population is known from at least 35 miles downstream.

Prescribed burning is proposed for the entire Indiana Bat Habitat Restoration Project area. Prescribed burns are conducted under conditions that preserve ground cover and reduce the potential for sedimentation. Forest Plan standards will maintain stream quality during temporary road or fireline construction.

Established protocols such as transporting small amounts of herbicide (never more than that needed for one day), transporting herbicide in original containers, mixing herbicides away from water sources and at the site of application, and utilizing established containment and clean-up procedures in the event of a spill will significantly reduce the possibility of accidental contamination of aquatic habitats.

The proposed project area is bordered by the White River on the east and northeast sides. Observance of SMZs will limit sediment contributions and will not alter the flow of the White River. Only herbicides approved for aquatic use will be used to treat non-native invasive plant infestations within the SMZ adjacent to the White River in which this species occurs. Therefore there will be **no effect** to the **pink mucket**.

Rich Woods Habitat and Associated Species

No threatened or endangered species are found in this habitat except possibly some of the bat species which are covered in their own category below. Rich woods habitat is characterized by high moisture levels and fertile, productive soils. Most frequently, this habitat occurs in drains, on lower slopes, or in bottomlands, but pockets may also exist around seeps and springs. General forest types within this group include mixed oak and oak-hickory, although pine can also be present. These conditions can be found in any age class, although species associated with this habitat type frequently benefit from some shade producing cover. On the Sylamore Ranger District, lower

slopes along the streams and areas around springs or seeps appear to offer more moist and fertile soil than the surrounding ridgetops and glades.

Open or Disturbed Woods Habitat and Associated Species

No threatened or endangered species are found in this habitat except possibly some of the bat species which are covered in their own category below. Open woods can be present in a variety of conditions including small gaps in old growth forests, woods with interspersed grassland or disturbed woods. Examples of such areas can be rights-of-way (such as roads and utility corridors) wildlife openings, pastures, or areas cleared by natural disturbances. Species in this group may be associated with one or more of these natural or human-caused disturbances. Sites that could offer this type of habitat within the project area include road rights-of-way, glades, wildlife openings and range and hay allotments.

Glades and Rocky Outcrop Habitats and Associated Species

Missouri bladderpod

Rock outcrops on the District generally occur as sandstone or limestone rock exposures. These outcrops can take several forms including exposed rock on the surface of the landscape, glades, talus slopes, and in their most striking forms, cliffs and bluffs. Some outcrops may be artificially created such as those that can occur along road cuts. The species included in this category are restricted to or show a preference for these habitats. Large glade areas and rocky outcrops along roadsides are present across the Sylamore Ranger District. Currently many of the glades have lost most of their characteristically open nature, and are being shaded out by encroaching trees. The above listed species has never been located during any field surveys in the Indiana Bat Habitat Restoration Project area including glade assessments done by Doug Zollner from TNC (2011-present).

Observations of dormant season prescribed fires on the District indicate that glades and rocky outcrops do not carry fire well at that time of year; it is possible that fires will carry better and have a more beneficial effect on this habitat type when they are conducted in the growing season. Firelines may pass though glades; when they do, mist blowers may be used on the uneven and rocky terrain to prevent potential impacts from heavy equipment.

Requirements of Forest Plan standard FW28 will be observed to ensure herbicide applications will not affect known individuals or populations of Missouri bladderpod; therefore, it is not expected to be effected by these treatments.

Missouri bladderpod is not known from the District; therefore the project is considered to have **no effect** on this species.

Karst Habitat and Associated Species

Hell Creek Cave crayfish

Karst is a geological landform type created when limestone is dissolved by moving water. It is characterized by the presence of sinkholes, caves, and streams that disappear or resurge from underground, and springs where water resurfaces. Karst topography is complex and affects waterflow. Subsurface water movement may not follow surface drainage patterns. Karst areas could be potentially affected by pesticides, agricultural fertilizers, sewage systems, development, dumping, and excess sediment movement on the surface which could block sinks and karst windows, affecting water movement patterns below ground. Karst underlays the entire Sylamore Ranger District; caves and other karst features are wide-spread. Over 300 caves and 130 springs are known from the District and there is potential to find additional sites.

Karst habitats are difficult to survey because they are underground; passages can be dangerous, underwater, or too narrow to admit humans. It is also difficult to predict or discover if a known cave system connects to another system. Cave biota are frequently difficult to identify and may need to be removed and sent to specialists. Extensive cave inventories conducted between 2000 and 2002 identified over 230 species using 35 caves, including four species that were new to science. (Not all species discovered in caves, such as the black rat snake, require caves to live in.) A paper published by Graening et al. (2003) stated that a collector's curve indicated that additional species would likely be found with additional surveys.

The Hell Creek Cave crayfish has not been encountered on the Sylamore District, including surveys at Blanchard Springs Caverns, the largest known cave system on the District. The distribution of the Hell Creek Cave crayfish is not likely to expand based on the number of other cave systems within the potential range that have been searched without success. The recharge areas for known cave populations do not extend on to Forest Service lands and populations in caves off of Forest Service lands are not being affected by activities on the Forest.

Forest Plan standards regarding restrictions within karst management zones will be implemented.

When considering the location of the proposed work in relation to the known and probable distribution of this species and the requirements to Forest Plan standards, this project will have **no effect** on the **Hell Creek Cave crayfish**.

BATS

Gray bat
Indiana Bat
Ozark big-eared bat

Bats are considered separately here because they are wide-ranging and are known to use a variety of habitats for roosting, feeding, and maternity and hibernation sites. They include all habitat classes already discussed. The gray bat uses many caves (both in summer and winter) across the District

and forages over streams. Six of the District's caves are known Indiana bat hibernacula (5 extant and one historic).

Prescribed burning operations will follow Forest Plan standards, including identifying all hibernacula as smoke sensitive targets. Prescribed burning will be planned when conditions (such as wind direction and mixing height) make it unlikely that large levels of smoke will come near the caves. Ignition patterns may be adjusted to ensure smoke movement away from hibernacula. Atmospheric conditions will be monitored and weather reports reviewed during the burn. Firing will be terminated if changing conditions cause smoke movement that is likely to impact hibernacula.

In addition to the standards to protect caves used by rare bats, the Forest Plan includes standards for prescribed burning and timber management within the primary and secondary zones that will result in direct benefits for the Indiana bat. These include thinning stands to reduce canopy closure and using repeated prescribed burning to maintain these conditions. Reduced canopy closure will provide improved foraging and roosting opportunities for this species and increase the potential for establishment of regeneration. These Forest Plan standards are incorporated into the Indiana Bat Habitat Restoration Project.

Because actions involve the removal of larger diameter trees and creating smoke during burning, if these trees are occupied by Indiana bats at the time of felling or burning they could be disturbed or perish. Before burning or tree harvesting can occur during the active period of the Indiana bat (currently believed to be between March 15 and November 30) can be done, mist netting surveys will be conducted in accordance with guidelines established by the U.S. Fish and Wildlife Service to determine presence or probable absence of the species. The results of these surveys will be used to determine the time of year that the harvest or burns can take place in the surveyed area; harvesting and burning will not be conducted during the active period if Indiana bats are found to use the surveyed area within that timeframe to protect them from harm. The results of these surveys will be good for two years, at which time they will be repeated if harvesting or prescribed burning is to be continued during the Indiana bat's active period.

In most cases, bats will readily move from one suitable roost tree to another if the tree is lost or disturbance occurs. Because all known hibernacula will be protected during prescribed burning and the proposed timber and prescribed burning actions will follow Forest Plan standards and may provide direct benefits for the **Indiana bat**, the species has a determination of **not likely to adversely affect**.

The remaining bat species use the general forest area during the spring, summer, and fall as flyways and for feeding, but utilize caves for roosting year-round. The occurrence of the Ozark big-eared bat on the District is uncertain, and if they occur, it is only likely on the western portion of the District in Searcy County. Therefore Ozark big-eared bats are not likely to be found in the proposed project area.

Forest Plan standard prohibits application of herbicide within karst management zones and restricts the use of equipment for activities such as during timber harvest or prescribed fire line construction. When considering these protective measures in relation to the gray bat and the Ozark big-eared bat, there will be **no effect** on the **gray bat** or the **Ozark big-eared bat**.

CONCLUSION AND DETERMINATION OF EFFECTS

Effects for Alternative 2

___X___ No effect

1. Gray bat
2. Ozark big-eared bat
3. Pink mucket
4. Hell Creek Cave crayfish
5. Missouri bladderpod

Rationale: A determination of **no effect** was made for the above species (1-6). **Gray bats** may utilize the area for foraging. **Ozark big-eared bats** are not known to occur on the District despite extensive searches in the most likely portion of the District which is outside the project area. Foraging habitat for these species will not be negatively impacted by the proposed project activities and implementation of Forest Plan standards including karst management zones will protect any caves that may receive occasional undocumented use. The proposed project is far enough away that it is unlikely to connect to the karst habitat used by the **Hell Creek Cave crayfish**. **Missouri bladderpod** is not known from the project area, nor is it expected to occur there.

___X___ Not likely to adversely effect

1. Indiana bat

Rationale: The project area will be surveyed for **Indiana bats** according to U.S. Fish and Wildlife Service guidelines before prescribed burning or timber harvests take place during the active period of the bat (currently believed to be March 15 through November 30). If Indiana bats are captured during surveys, thinning and burning will be restricted to the hibernation period of the bat in the surveyed area unless additional coordination with U.S. Fish and Wildlife is completed. If they are not captured, tree cutting and burning may proceed at any time of year for two years following the date of the survey. This survey, the subsequent decision of the timing of the project, and following Forest Plan standards which protect and enhance Indiana bat habitat will reduce the possibility that Indiana bats are harmed.

_____ Likely to adversely effect

Rationale: There are no threatened or endangered species which this project is likely to adversely affect.

The remaining Threatened and Endangered Species found in Table 1 (13 species) that are **not** in bold print have a **no effect** finding. These species do not occur, nor are they expected to occur, on the Sylamore Ranger District due to the geographic location of the District in relation to the known and historic ranges of these species. Since these species do not occur on the Sylamore Ranger District, they will not be affected by the project. Further, no habitats that might be used as recovery areas for any of the above species will be affected by this project.

Effects for Alternative 3

___X___ No effect

1. Gray bat
2. Ozark big-eared bat
3. Pink mucket
4. Hell Creek Cave crayfish
5. Missouri bladderpod

Rationale: A determination of **no effect** was made for the above species (1-6). **Gray bats** may utilize the area for foraging. **Ozark big-eared bats** are not known to occur on the District despite extensive searches in the most likely portion of the District. Foraging habitat for these species will not be negatively impacted by the proposed project activities and implementation of Forest Plan standards including karst management zones will protect any caves that may receive occasional undocumented use. The proposed project is far enough away that it is unlikely to connect to the karst habitat used by the **Hell Creek Cave crayfish**. **Missouri bladderpod** is not known from the project area, nor is it expected to occur there.

___X___ Not likely to adversely effect

2. Indiana bat

Rationale: The project area will be surveyed for **Indiana bats** according to U.S. Fish and Wildlife Service guidelines before prescribed burning or timber harvests take place during the active period of the bat (currently believed to be March 15 through November 30). If Indiana bats are captured during surveys, thinning and burning will be restricted to the hibernation period of the bat in the surveyed area unless additional coordination with U.S. Fish and Wildlife is completed. If they are not captured, tree cutting and burning may proceed at any time of year for two years following the date of the survey. This survey, the subsequent decision of the timing of the project, and following Forest Plan standards which protect and enhance Indiana bat habitat will reduce the possibility that Indiana bats are harmed.

_____ Likely to adversely effect

Rationale: There are no threatened or endangered species which this project is likely to adversely affect.

The remaining Threatened and Endangered Species found in Table 1 (13 species) that are **not** in bold print have a **no effect** finding. These species do not occur, nor are they expected to occur, on the Sylamore Ranger District due to the geographic location of the District in relation to the known and historic ranges of these species. Since these species do not occur on the Sylamore Ranger District, they will not be affected by the project. Further, no habitats that might be used as recovery areas for any of the above species will be affected by this project.

Prepared by:

/s/ Jessica Wakefield — 03 April 2013

_____ _____

Jessica Wakefield — Date
Zone Wildlife Biologist
Sylamore and St. Francis Ranger Districts
Ozark-St. Francis National Forests

LITERATURE CITED

Arkansas Natural Heritage Commission. 2010a. Rare Species Search Engine. http://www.naturalheritage.com/research-data/rarespecies-search.aspx. Accessed February 25, 2013.

Arkansas Natural Heritage Commission. 2010b. Database. Plant and animal EORS within Forest Service Administrative Boundaries.

Clark, B.S., D.M. Leslie,Jr., and T.S. Carter. 1993. Foraging Activity of Adult Female Ozark Big-eared Bats (*Plectus townsendii ingens*) in Summer. Journal of Mammalogy 74:422-427.

Graening, G.O et al 2006. Range Extension and Status Update of the Enangered Hell Creek Cave Crayfish, Cambarus zophonastes (Decapoda: Cambaridae). The Southwestern Naturalist. Volume 51, number 3, pp. 392-396.

Graening, G.O et al 2003. Subterranean Biodiversity of Arkansas Part 1. Bioinventory and Bioassessment of Caves in the Sylamore Ranger District, Ozark National Forest, Arkansas. Journal of the Arkasas Academy of Science. Volume 57, 2003.

Harvey, Michael J. 1979 to 2006. Reports to the Ark. Game and Fish, U.S. Forest Service of the Status of Endangered Bats on the Sylamore Ranger District. Report produced by Ecological Research Center, Department of Biology, Memphis State University, Memphis, Tennessee.

Hendrix, Earl. 2005. USFS. Unpublished field notes.

Menzel, Michael A., Jennifer Menzel, Tmothy Carter, W. Mark Ford, John W. Edwards. 2001. Review of the forest habitat relationship of the Indiana bat (Myotis sodalis). Gen. Tech. Rep. NE-284. Newton Square, Pennsylvania: USDA, Forest Service, Northeastern Research Station. 21 pp.

MDC 2012. "Three cases of bat disease discovered in Missouri". Missouri Department of Conservation online http://mdc.mo.gov/newsroom/three-cases-bat-disease-discovered-missouri accessed January 2, 2013.

Mott, D. N. and J. Laurens. 2004. Water Resource Management Plan: Buffalo National River, Arkansas. USDI, National Park Service, Buffalo National River, Harrison, Arkansas. 160 pp.

Moulton, S. R. II and K. W. Stewart. 1996. Memoirs of the American Entomological Institute: Caddisflies (Trichoptera) of the Interior Highlands of North America. Volume 56. The American Entomolofical Institute, Gainesville, Florida. 313 pp.

NatureServe. 2012. NatureServe Explorer: An online encyclopedia of life [web application]. Version 7.1 NatureServe, Arlington, Virginia. Available http://www.natureserve.org/explorer.

Redman, Ron and Blake Sasse. 2006 to present. Endangered bat monitoring on the Sylamore Ranger District. Unpublished field notes.

Risch, Tom. 2004 to present. Indiana bat compliance surveys on the Sylamore Ranger District. Unpublished field notes.

Robison, H et al. 2008. The Arkansas Endemic Biota: An Update with Additions and Deletions. Journal of the Arkansas Academy of Science, volume 62 pp. 84-96.

Robison, H.W. and T.M. Buchanan. 1988. Fishes of Arkansas. The University of Arkansas Press, Fayetteville, Arkansas.

TNC 2012. Holliday, C. 2012 White-nose Syndrome Disease Surveillance and Bat Population Monitoring Report: A Repot of the Tennessee WNS Response Cooperators. Tennessee Chapter of the Nature Conservancy. July 2012 accessed @ http://www.caves.org/WNS/TN%202012%20White%20Nose%20Syndrome%20Report.pdf January 2, 2013.

USDA Forest Service 2011a. SERA TR 052-22-03b and SERA TR-052-22-03a-App. Forest Health Protection. Glyphosate: Human Health and Ecological Risk Assessment Final Report and Appendices. Syracuse Environmental Research Associates. www.fs.fed.us/foresthealth/pesticide/risk.shtml

USDA Forest Service. 2011b. SERA TR 052-29-03a. Forest Health Protection. Imazapyr: Human Health and Ecological Risk Assessment Final Report. Syracuse Environmental Research Associates. www.fs.fed.us/foresthealth/pesticide/risk.shtml

USDA Forest Service 2011c. SERA TR 052-25-03a and SERA TR-052-25-03a-App. Forest Health Protection. Triclopyr: Human Health and Ecological Risk Assessment Final Report and Appendices. Syracuse Environmental Research Associates. www.fs.fed.us/foresthealth/pesticide/risk.shtml

USDA Forest Service. 2005a. Revised Land and Resource Management Plan, Ozark-St. Francis National Forests. Available at http://www.fs.usda.gov/land/osfnf/landmanagement.

USDA Forest Service. 2005b. Final EIS for the Revised Land and Resource Management Plan, Ozark-St. Francis National Forests. Available at http://www.fs.usda.gov/land/osfnf/landmanagement.

USDA Forest Service. 2004a. Field notes, reports from Center For Aquatic Technology Transfer's (CATT) survey of North Sylamore, Bad Branch, Stewart, Cole and Cap Fork Creeks. Mountain View, Arkansas.

USDA Forest Service. 2004b. Field notes, reports, monitoring records referenced in the Biological Evaluation for the "Sylamore Prescribed Burning Projects For FY 2005- 2010", Mountain View, Arkansas.

USDA Forest Service. 2003. Field notes, report, pictures, etc. from the "Rosson Hollow Prescribed Burning Smoke Contaminant Monitoring" by R.Odegard and M. Caviness, Ozark-St. Francis National Forest, Boston Mountain Ranger District, Ozark, Arkansas.

USFWS. 2012. Hell Creek Cave Crayfish (*Cambarus zophonastes*) 5 year Review: Summary and Evaluation. Arkansas Ecological Services Field Office, Conway, Arkansas. August 2012.

USFWS. 2010a. A National Plan for Assisting States, Federal Agencies, and Tribes in Managing White-Nose Syndrom in Bats. Accessed at www.fws.gov/WhiteNoseSyndrome/ on August 27, 2012.

USFWS. 2010b. Endangered and Threatened Wildlife and Plants; Review of Native Species That Are Candidates for Listing as Endangered or Threatened; Annual Notice of Findings on Resubmitted Petitions; Annual Description of Progress on Listing Actions. Federal Register volume 75, number 217.

USFWS. 2009a. White-nose syndrome in bats: Frequently Asked Questions.

USFWS. 2009b. Indiana Bat (*Myotis sodalis*) 5 Year Review: Summary and Evaluation. Bloomington Ecological Services Field Office, Bloomington, Indiana. September 2009.

USFWS. 2009c. Gray Bat (*Myotis grisescens*) 5 Year Review: Summary and Evaluation. Columbia, Missouri Ecological Field Office, Columbia, Missouri. September 2009.

USFWS. 2008. Missouri Bladderpod (*Physaria filiformis*) 5 Year Review: Short Form Summary and Evaluation. U.S. Fish and Wildlife Service. Fort Snelling, Minnesota. April 2008.

USFWS. 2007. Indiana Bat (*Myotis sodalis*) Draft Recovery Plan: First Revision. U.S. Fish and Wildlife Service. Fort Snelling, Minnesota. January 2007

USFWS. 1995. Ozark Big-Eared Bat (*Corynorhinus townsendii ingens*) Revised Recovery Plan. U.S. Fish and Wildlife Service. Tulsa, Oklahoma. March 1995.

USFWS. 1988a. *Cambarus zophonastes* Recovery Plan. U.S. Fish and Wildlife Service. Atlanta,
Georgia. September 1988.

USFWS. 1988b. Missouri Bladderpod (*Physaria filiformis*) Recovery Plan. U.S. Fish and Wildlife
Service. Twin Cities, Minnesota. April 1988.

USFWS. 1985. Recovery Plan for the Pink Mucket Pearly Mussel, *Lampsilis abrupta* (Hildreth, 1828). U.S. Fish and Wildlife Service. Atlanta, Georgia. January 1985.

USFWS. 1982. Recovery Plan for the Gray Bat, *Myotis grisescens*. U.S. Fish and Wildlife Service. July 1982.

Whalen, Rhea S. 2004. Field notes, survey records for the "Sylamore Prescribed Burning Projects For FY 2005-2010", Mountain View, Arkansas.

Wilson, Steve. 2004. Personal communication from S. Wilson, AGFC to Rhea Whalen, USFS Biologist.

WNS decontamination protocols
http://whitenosesyndrome.org/sites/default/files/resource/national_wns_revise_final_6.25.12.pdf

Zollner, Douglas. 2011 to present. The Nature Conservancy. Ecological Assessment of Glades on the Eastern Portion of the Sylamore Ranger District. Unpublished field data and communication to Jessica Wakefield, USFS Biologist.

APPENDIX 1

Survey Records

Survey records for the Indiana Bat Habitat Restoration Project will be conducted as treatments are prescribed. Surveys on file covered similar habitat while considering identical actions (timber harvest, mechanical treatments, prescribed fire, temporary road and fireline construction). Data accumulated by the Arkansas Natural Heritage Commission for the Sylamore Ranger District and the adjacent White River was also utilized. This information is sufficient to determine which species occur or are likely to occur within the District boundaries, establish habitat associations for those species, and determine how proposed project actions could affect the species or their habitat. Species were assumed to be present in any suitable habitat for the effects analysis.

All surveys, reports, field notes, or their results are located at the Sylamore Ranger District Office in Mountain View, Arkansas. Many areas in the proposed project area were previously surveyed by Forest Service personnel including S. Barrow, E. Foster, K. Goodwin, T. Rogers, R. Odegard, K. Tinkle, E. Hendrix, P. Hyatt, and R. Whalen. Surveys consisted of walking the ground on foot to look for species and unusual habitats.

Understanding of species and their habitat requirements is based on District-specific surveys performed over the years. These include:

- Aquatic habitat inventories of North Sylamore Creek, Cole Fork, Cap Fork, and Bad Branch Creeks by CATT Crew (USFS, Center for Aquatic Technology Transfer), June 2004 and Livingston Creek and tributaries of the White River during the summer of 2007.
- Fisheries/aquatic habitat surveys of North Sylamore, Cole Fork, Stewart Fork, and Livingston Creeks by Arkansas Tech University fisheries grad students, 2004-2005.
- District-wide botanical surveys by Phil Hyatt (USFS, Biologist) 1990-1992.
- Endangered bat monitoring by Blake Sasse (AGFC, Non-Game Biologist), 2006-present; Dr. Michael Harvey (Tennessee Tech University), 1978-2006; Ron Redman (ASWCC), David Kampwerth (USFWS, Biologist), Dr. G.O. Graening (TNC, Ecologist), and Dr. Shelly McGinnis (TNC), 1999-present.
- Water quality monitoring of North Sylamore Creek (Hydrologic Benchmark Network Station) by James Peterson (USGS, Hydrologist), 1963-present.
- Eagle nest surveys and monitoring by Steve Wilson (AGFC, Sylamore WMA Biologist) and Rhea Whalen (USFS, Biologist), 2002 and 2004.
- Landbird point counts by Glen Thomas (contractor), 1998-present.
- Fisheries surveys by Arkansas Game and Fish Biologists and USGS Biologist of the White River, 1993-present.

- Ozark Chinquapin and ginseng permanent plot monitoring by Meryl Hattenbach (ANHC, Ecologist), Earl Hendrix (USFS, Forestry Technician), and Kevin Goodwin (USFS, Wildlife Technician) 1998-present.
- Bat mist netting surveys conducted by Dr. Michael Harvey (Tennessee Tech University), Dr. J.D. Wilhide (Arkansas State University), Blake Sasse (AGFC, Non-Game Biologist), Steve Brandebura (Arkansas State University), Tom Risch (Arkansas State University) 1970's-present.
- Karst feature inventory by Dave Taylor and the Association for Arkansas Cave Studies, 2000-2009.
- Bluffline/cave surveys by Bill Puckett (USFWS, Tulsa, Biologist), 1998-2004.
- Bioinventory and Bioassessment of Caves in the Sylamore Ranger District by Dr. G.O. Graening (TNC, Ecologist), Mike Slay (University of Arkansas) and Karen Tinkle (USFS, Wildlife Biologist, Sylamore RD), 2000-2002.
- Two *Silene regia* sites were reported to the author by Phil Hyatt, former US Forest Service employee, who discovered the plants while hiking along the Ozark Highlands Trail (personal communication to K. Furr June 24, 2008).
- Glade inventory and assessment in Indiana Bat Habitat Restoration Project area by Douglas Zollner (TNC, Director of Science for The Nature Conservancy), 2011-present.

APPENDIX 2

White-nose Syndrome

White-nose syndrome (WNS) is a disease responsible for unprecedented mortality in hibernating bats in the northeastern U.S. WNS was first observed in 4 caves near Albany, New York in the winter of 2006/2007. Photographs subsequently emerged of apparently affected bats in nearby Howes Cave, New York, taken during the previous winter, providing the earliest evidence of the disease. As of August 2012, WNS was detected in 7 species of hibernating bats that occur in the affected region (Alabama, Connecticut, Delaware, Georgia, Illinois, Indiana, Kentucky, Maine, Maryland, Massachusetts, Missouri, New Hampshire, New Jersey, New York, North Carolina, Ohio, Pennsylvania, South Carolina, Tennessee, Vermont, Virginia, and West Virginia). Affected sites have also spread into 5 Canadian Provinces (http://whitenosesyndrome.org/ accessed March 13, 2013). The effects of WNS appear to vary between species and winter hibernation sites, but overall colony losses at the most closely monitored sites have reached 95 percent within 2 to 3 years of initial detection. Species known to be susceptible to WNS thus far are the little brown bat (*Myotis lucifugus*), Indiana bat (*M. sodalis*), gray bat (*M. grisescens***)** northern long-eared bat (*M. septentrionalis*), eastern small-footed bat (*M. leibii*), tricolored bat (*Perimyotis subflavus*), and big brown bat (*Eptesicus fuscus*). The cave bat (*M. velifer*) and the southeastern bat (*M. austroriparius*) have also tested positive for the presence of *Geomyces destructans*, the fungus associated with WNS, but not with the infection that is characteristic of the disease. The presence of the fungus (*G. destructans*) was additionally confirmed in Iowa and Oklahoma, and this discovery could portend the spread of WNS into new regions of the southeastern and western U.S. The disease appears to affect bats most during long torpor bouts characteristic of winter hibernation. Therefore, bat species that use hibernation as a strategy for surviving the winter months, collectively called the "cave bats", are most notably affected. It is not currently known if WNS is causing mortality in bats that use torpor during winter but do not regularly occur in caves and mines, such as the so called migratory "tree bats".

White-nose syndrome was named for the visible presence of a white fungus around the muzzles, ears, and wing membranes of affected bats. Scientists recently identified a previously unknown species of cold-loving fungus *(G. destructans)* as a consistent pathogen causing skin infection in bats at affected sites. This fungus thrives in low temperatures (5-14º C; 40-55º F) and high levels of humidity (>90 %), conditions characteristic of many bat hibernacula. Pathologic findings thus far indicate that such fungal infections can be detected as early as October, and it is hypothesized that bats affected by WNS arouse from hibernation more frequently, and/or for longer periods than normal, and are prematurely expending the fat reserves they rely on for winter survival. Chronic disturbance of hibernating bats has been known to cause high rates of winter mortality through fat loss, and aberrant behaviors associated with WNS may cause bats to consume critical fat reserves prematurely during winter. Aberrant behaviors observed at sites affected by WNS include shifts of large numbers of bats in hibernacula to locations near the entrances or unusually cold areas; large numbers of bats dispersing during the day from hibernacula, even during mid-winter; a general unresponsiveness to human disturbance; and, on occasion, large numbers of fatalities, either inside the hibernacula, near the entrance, or in the

immediate vicinity of the entrance. Additionally, recent hypotheses suggest that the characteristic wing pathology associated with WNS may cause death by disruption of important wing-dependent physiological functions, such as water balance, thermoregulation and mechanical function of the wing leading to dehydration, increased thirst-mediated arousals, increased heat loss, and inhibition of flight. Although evidence indicates that skin infection by *G. destructans* is the plausible primary cause of mortality associated with WNS, the exact processes by which skin infection leads to death remain undetermined, and it is unclear the extent to which other conditions may contribute to susceptibility of species or individuals to fungal infection and/or mortality.

All information in the above proceeding paragraphs taken from the May, 2011 version of "A National Plan for Assisting States, Federal Agencies, and Tribes in Managing White-nose Syndrome in Bats" (accessed at http://whitenosesyndrome.org/ November 29, 2012).

In states adjacent to Arkansas, the presence of WNS was confirmed in three bats from two caves in Lincoln County, MO in 2012; evidence of *G. destructans* was first detected in Missouri in April 2010 on a bat found in a privately owned cave in Pike County, and in May of that year on six bats netted outside a public cave in Shannon County (MDC 2012). In Tennessee, the number of confirmed WNS positive counties has doubled between 2011 and 2012 (TNC 2012).

To date, *G. destructans* has not been identified in hibernating bat colonies in Arkansas. Surveys for indications of the disease were conducted on the Sylamore Ranger District during the winter of 2011/2012 and 2012/2013 with help of the Arkansas Game and Fish Commission.

To reduce the possibility that the fungus is spread from equipment or the clothing of individuals entering caves, the Northern and Southern Regions of the US Forest Service have issued closure orders for caves within National Forest managed lands. At this time, only Blanchard Springs Caverns, valued for its recreation and interpretive opportunities, remains open. Blanchard is known to be used by gray bats and occasionally by Indiana bats in very low numbers. Blanchard is not used by Ozark big-eared bats. Visitors are screened before they attend cave tours to determine if they have potentially visited an affected area. To reduce the risk of human-caused transmission of *G. destructans* into the cave, clothing and items that have been in other caves within the last ten years are not allowed in Blanchard; shoes that may have been worn by visitors in other caves within the last ten years are disinfected prior to the tour. WNS decontamination protocols recognized to be sufficient by the USFWS and AGFC were developed by a multi-agency WNS Decontamination Team and can be found at http://whitenosesyndrome.org/sites/default/files/resource/national_wns_revise_final_6.25.12.pdf. These protocols are currently being followed at Blanchard Springs Caverns.

SENSITIVE SPECIES ASSESSMENT REPORT
FOR THE
INDIANA BAT HABITAT RESTORATION PROJECT

Sylamore Ranger District
Ozark-St. Francis National Forests
USDA Forest Service, Southern Region
Prepared by: Jessica Wakefield, Wildlife Biologist

Thirty-two species occurring or having the potential to occur on the Ozark-St. Francis National Forests have been identified by the Regional Forester (Region 8) as Sensitive. These species are listed in Table 1 below.

Table 1. Regional Forester's Sensitive species which occur or have the potential to occur on the Ozark-St. Francis National Forests. These species are considered in this report.

Taxon	Scientific Name	Common Name	Global Rank	Ozark NF Presence	Project Area Presence
Mammal	***Myotis leibii***	**Eastern small-footed bat**	**G1G3**	**1**	**1**
Bird	*Aimophila aestivalis*	Bachman's sparrow	G3	1	3
Bird	***Haliaeetus leucocephalus***	**Bald Eagle**	**G5**	**1**	**2**
Amphibian	*Eurycea tynerensis*	Oklahoma salamander	G3	1	3
Fish	***Notropis ozarcanus***	**Ozark shiner**	**G3**	**1**	**2**
Fish	*Percina nasuta*	Longnose darter	G3	1	3
Fish	***Typhlichthys subterraneus***	**Southern cavefish**	**G4**	**2**	**3**
Crustacean	*Orconectes williamsi*	William's crayfish	G3	1	3
Mollusk	*Lampsilis rafinesqueana*	Neosho mucket	G2	1	3
Insect	***Paduniella nearctica***	**Nearctic paduneillan caddisfly**	**G1G2**	**1**	**1**
Isopod	***Lirceus bicuspidatus***	**An isopod**	**G3Q**	**1**	**2**
Plant	*Amorpha ouachitensis*	Ouachita false indigo	G3Q	1	3
Plant	*Callirhoe bushii*	Bush's poppymallow	G3	1	3
Plant	***Castanea pumila var. ozarkensis***	**Ozark chinquapin**	**G5T3**	**1**	**1**
Plant	***Cypripedium kentuckiense***	**Southern Lady's slipper**	**G3**	**1**	**3**
Plant	***Delphinium newtonianum***	**Newton's larkspur**	**G3**	**1**	**2**
Plant	***Delphinium treleasei***	**Glade larkspur**	**G3**	**1**	**2**
Plant	*Dodecatheon frenchii*	French's shooting star	G3	1	3
Plant	***Draba aprica***	**Open-ground draba**	**G3**	**1**	**1**

Plant	*Eriocaulon koernickianum*	Gulf pipewort	G2	1	3
Plant	*Fothergilla major*	Large witchalder	G3	2	3
Plant	***Juglans cinerea***	**Butternut**	**G4**	**1**	**2**
Plant	*Neviusia alabamensis*	Alabama snow-wreath	G2	1	3
Plant	*Quercus acerifolia*	Mapleleaf oak	G1	1	3
Plant	*Schisandra glabra*	Bay starvine	G3	1	3
Plant	***Silene ovata***	**Ovate leaf catchfly**	**G3**	**1**	**1**
Plant	***Silene regia***	**Royal catchfly**	**G3**	**1**	**2**
Plant	*Solidago ouachitensis*	Ouachita Mountain goldenrod	G3	2	3
Plant	***Tradescantia ozarkana***	**Ozark spiderwort**	**G3**	**1**	**2**
Plant	***Trillium pusillum var. ozarkanum***	**Ozark least trillium**	**G3T3**	**1**	**3**
Plant	*Valerianella nuttallii*	Nuttall's cornsalad	G1?	2	3
Plant	***Valerianella ozarkana***	**Ozark cornsalad**	**G3**	**1**	**2**

NatureServe Global Conservation Status Ranks

G1 = Critically Imperiled- At very high risk of extinction due to extreme rarity (often 5 or fewer populations), very steep declines, or other factors.

G2 = Imperiled- At high risk of extinction due to very restricted range, very few populations (often 20 or fewer), steep declines, or other factors.

G3 = Vulnerable- At moderate risk of extinction due to a restricted range, relatively few populations (often 80 or fewer), recent and widespread declines, or other factors.

G4 = Apparently Secure- Uncommon but not rare; some cause for long-term concern due to declines or other factors.

G5 = Secure- Common; widespread and abundant.

G#G# = Range rank- A numeric range rank is used to indicate the range of uncertainty in the status of a species or community. A G2G3 rank would indicate that there is a roughly equal chance of G2 or G3 and other ranks are much less likely. Ranges cannot skip more than one rank.

Rank Qualifiers

Q = Questionable Taxonomy- Taxonomic distinctiveness of this entity at the current level is questionable; resolution of this uncertainty may result in change from a species to a subspecies or hybrid, or the inclusion of this taxon in another taxon, with the resulting taxon having a lower-priority conservation priority.

? = Inexact Numeric Rank- Denotes some uncertainty about the numeric rank. (e.g. G3? – Believed most likely a G3, but some chance of either a G2 or G4).

T#- Intraspecific Taxon (trinomial)- The status of intraspecific taxa (subspecies or varieties) are indicated by a "T-rank" following the global rank. Rules for assigning T-ranks fallow the same principles for global conservation status ranks.

Project Area Presence Codes

1= Species is known to occur within the project area.

2= Species is not currently known from the project area but may occur within the project area due to the presence of suitable habitat.

3= Species is not currently known from the project area and is not likely to occur there due to habitat requirements or geographic distribution.

Determination of Effect for Regional Forester's Sensitive Listed Species

Fifteen Regional Forester's Sensitive listed species, taken from Table 1 above were eliminated from consideration for projects on the Sylamore District of the Ozark-St. Francis National Forests because they do not occur on the Ozark National Forest or their known distribution is well outside the counties that make up the Sylamore Ranger District. These fifteen species are: Bachman's sparrow, Oklahoma salamander, longnose darter, William's crayfish, Neosho mucket, Ouachita false indigo, Bush's poppymallow, French's shooting star, gulf pipewort, large witchalder, Alabama snow-wreath, mapleleaf oak, bay starvine, Ouachita Mountain goldenrod, and Nuttall's cornsalad. Therefore the proposed project will have **no impact** on these species and they will not be considered further in this report.

The remaining seventeen Regional Forester's Sensitive listed species have the potential to occur on the Sylamore Ranger District due to suitable habitat or nearby records. These species are indicated in **bold print** in Table 1.

Summary of Developed Alternatives

The following documents are incorporated by reference: Revised Ozark-St. Francis National Forest Land and Resource Management Plan (Forest Plan) (USDA Forest Service 2005a), the Final Environmental Impact Statement (FEIS) for the Forest Plan (USDA Forest Service 2005b), and the SERA Human Health and Ecological Risk Assessments for Glyphosate, Imazapyr, and Triclopyr (USDA Forest Service 2011a,b,c).

Human Health and Ecological Risk Assessments (risk assessments) have been completed for the herbicides proposed for use. In these documents, the process of risk assessment is used to quantitatively evaluate the probability (i.e. risk) that a pesticide use might pose harm to humans or other species in the environment. It is the same assessment process used for regulation of allowable residues of pesticides in food, as well as safety evaluations of medicines, cosmetics, and other chemicals. The current risk assessments and associated worksheets for glyphosate, imazapyr, and triclopyr were prepared in 2011((USDA 2011a, b, and c respectively).

With respect to herbicide use proposed in Alternatives 2 and 3, low rates of use, adherence to Forest Plan standards and label requirements, and established handling practices mitigate the potential for negative impacts. The cited risk assessments for glyphosate, triclopyr and imazapyr indicate there is no plausible basis for asserting applications as proposed pose substantial risk.

Alternative 1 - No Action

Under the No-Action Alternative, none of the vegetation management or wildlife habitat improvement activities of the proposed action alternative would be implemented. The condition of the proposed project area will be influenced by previously approved management actions, natural processes and events, routine maintenance of developed recreation areas and roads, and management actions necessary to protect public safety.

Alternative 2 - Proposed Action

Treatments proposed include installation of cave gates on extant hibernacula; commercial timber harvests (no more than 3,500 acres/year) and associated activities [construction of temporary roads, log landings and skid trails, road reconstruction (no more than 10 miles/year) and purchaser road maintenance (no more than 15 miles/year)]; reforestation (no more than 700 acres/year); site preparation and timber stand improvement (TSI) activities (no more than 2,000 acres/year of mechanical, chemical or burning treatments combined), wildlife stand improvement (WSI) activities (no more than 2,000 acres/year of mechanical, chemical or burning treatments combined), prescribed burning (an average of 15,000 acres/year) with no more than 2.0 miles of new mechanically constructed fire containment line/year; mechanical treatments (no more than 600 acres/year); and treatment of non-native invasive plant species (no more than 1,100 acres/year of mechanical, chemical and burning treatments combined). Interpretive displays or materials would be provided to the public throughout the duration of the project.

Treatments would be prescribed as stand examinations are completed or monitoring results trigger pre-determined actions. More detailed descriptions of the proposed activities are described in the Environmental Assessment for this project.

Alternative 3 - Reduced Herbicide

Under Alternative 3, gating hibernacula, harvest and associated actions to extract timber, prescribed burning and associated mechanical construction of prescribed fire containment line, mechanical treatments and treatment of non-native invasive plants would be as proposed for Alternative 2.

To accomplish TSI, site preparation and WSI work, only mechanical and prescribed burning treatments would be utilized. Multiple entries to repeat these actions would be made in each treatment unit, and growing season burning would be used more frequently than it would under Alternative 2. Annually, no more than 4,000 acres/year of TSI and site preparation/year and no more than 4,000 acres/year of WSI actions would be conducted.

Effects of Alternative 1-No Action

Of the Regional Forester's Sensitive species likely to occur on the Sylamore National Forest (those listed in **bold print** in Table 1 above), there is one bat species that would require cave gating proposed in the Indiana Bat Habitat Restoration project to protect it from harm if it is present in hibernacula to be gated in alternative 2 and 3. Human disturbance during hibernation for various reasons, including theft and vandalism, is one of the causes for decline in this species. Cave gating will also help protect these bats from white-nose syndrome (WNS) by limiting human to bat transmission of the fungus *Geomyces destructans*. Therefore, there will be a **likely to adversely impact** for the **eastern small-footed bat** if no action is taken. For the remaining Regional Forester's Sensitive species likely to occur on the Sylamore National Forest (those listed in **bold print** in Table 1 above), there will be **no impact**.

Species Evaluated

Eastern small-footed bat

Environmental Baseline

The Eastern small-footed bat is fairly widespread in southeastern Canada and the eastern U.S., but it is very spotty in distribution and rarely found in large numbers. Few high-quality occurrences exist; the total numbers counted are very low in comparison to the total number of caves and mines surveyed. This bat was ranked as a sensitive species due to the total number counted, the number of occurrences, with its susceptibility to disturbance also an important factor. Population size is not completely known. Prior to the recognition of white-nose syndrome, one total count for all known hibernacula was approximately 3,000 individuals, with roughly 60 percent of the total number from just two sites in New York. Some of the occurrences probably have not been surveyed completely, and some individuals are undoubtedly missed within some sites because they are hibernating in portions of mines or caves that cannot be reached or easily observed such as under large rocks or within rock piles. With the present scarcity of pertinent information, management can focus only on protection of hibernation caves and summer roosts (NatureServe 2012).

Eastern small-footed bats are uncommon throughout most of their range. The potential habitat for this species is all Ozark Forest Service lands of approximately 900,000 acres. This bat is known to occur in Crawford, Franklin, Johnson, Logan, Newton, Searcy and Stone Counties in Arkansas. Additional surveys are not needed to improve the determination of effects to this sensitive species, but are needed to further delineate the distribution of this species on the Forest.

In Arkansas, the eastern small-footed bat is known in small numbers from only a few caves in the Ozarks. It has been documented in caves in Stone County on the Sylamore Ranger District and infrequently netted in summer forest surveys within the project area (Risch 2004 to present). This species has also been documented in one of the caves proposed for gating under Alternative 2 and 3 of the Indiana Bat Habitat Restoration Project (Harvey 1979 to 2006 and Risch 2004 to present). Eastern small-footed bat distribution on the District is not well-understood, but scattered records indicate that the species is not limited geographically and has the potential to occur across the District.

White-nose Syndrome

White-nose syndrome (WNS) is a disease responsible for unprecedented mortality in hibernating bats in the northeastern U.S. WNS was first observed in 4 caves near Albany, New York in the winter of 2006/2007. Photographs subsequently emerged of apparently affected bats in nearby Howes Cave, New York, taken during the previous winter, providing the earliest evidence of the disease. As of August 2012, WNS was detected in 7 species of hibernating bats that occur in the affected region (Alabama, Connecticut, Delaware, Georgia, Illinois, Indiana, Kentucky, Maine, Maryland, Massachusetts, Missouri, New Hampshire, New Jersey, New York, North Carolina, Ohio, Pennsylvania, South Carolina, Tennessee, Vermont, Virginia, and West Virginia).

Affected sites have also spread into 5 Canadian Provinces (http://whitenosesyndrome.org/ accessed March 13, 2013). The effects of WNS appear to vary between species and winter hibernation sites, but overall colony losses at the most closely monitored sites have reached 95 percent within 2 to 3 years of initial detection. Species known to be susceptible to WNS thus far are the little brown bat (*Myotis lucifugus*), Indiana bat (*M. sodalis*), gray bat (*M. grisescens)* northern long-eared bat (*M. septentrionalis*), eastern small-footed bat (*M. leibii*), tricolored bat (*Perimyotis subflavus*), and big brown bat (*Eptesicus fuscus*). The cave bat (*M. velifer*) and the southeastern bat (*M. austroriparius*) have also tested positive for the presence of *Geomyces destructans*, the fungus associated with WNS, but not with the infection that is characteristic of the disease. The presence of the fungus (*G. destructans*) was additionally confirmed in Iowa and Oklahoma, and this discovery could portend the spread of WNS into new regions of the southeastern and western U.S. The disease appears to affect bats most during long torpor bouts characteristic of winter hibernation. Therefore, bat species that use hibernation as a strategy for surviving the winter months, collectively called the "cave bats", are most notably affected. It is not currently known if WNS is causing mortality in bats that use torpor during winter but do not regularly occur in caves and mines, such as the so called migratory "tree bats".

White-nose syndrome was named for the visible presence of a white fungus around the muzzles, ears, and wing membranes of affected bats. Scientists recently identified a previously unknown species of cold-loving fungus *(G. destructans)* as a consistent pathogen causing skin infection in bats at affected sites. This fungus thrives in low temperatures (5-14º C; 40-55º F) and high levels of humidity (>90 %), conditions characteristic of many bat hibernacula. Pathologic findings thus far indicate that such fungal infections can be detected as early as October, and it is hypothesized that bats affected by WNS arouse from hibernation more frequently, and/or for longer periods than normal, and are prematurely expending the fat reserves they rely on for winter survival. Chronic disturbance of hibernating bats has been known to cause high rates of winter mortality through fat loss, and aberrant behaviors associated with WNS may cause bats to consume critical fat reserves prematurely during winter. Aberrant behaviors observed at sites affected by WNS include shifts of large numbers of bats in hibernacula to locations near the entrances or unusually cold areas; large numbers of bats dispersing during the day from hibernacula, even during mid-winter; a general unresponsiveness to human disturbance; and, on occasion, large numbers of fatalities, either inside the hibernacula, near the entrance, or in the immediate vicinity of the entrance. Additionally, recent hypotheses suggest that the characteristic wing pathology associated with WNS may cause death by disruption of important wing-dependent physiological functions, such as water balance, thermoregulation and mechanical function of the wing leading to dehydration, increased thirst-mediated arousals, increased heat loss, and inhibition of flight. Although evidence indicates that skin infection by *G. destructans* is the plausible primary cause of mortality associated with WNS, the exact processes by which skin infection leads to death remain undetermined, and it is unclear the extent to which other conditions may contribute to susceptibility of species or individuals to fungal infection and/or mortality.
All information in the above proceeding paragraphs taken from the May, 2011 version of "A National Plan for Assisting States, Federal Agencies, and Tribes in Managing White-Nose Syndrome in Bats" (accessed at http://whitenosesyndrome.org/ November 29, 2012).

In states adjacent to Arkansas, the presence of WNS was confirmed in three bats from two caves in Lincoln County, MO in 2012; evidence of *G. destructans* was first detected in Missouri in April 2010 on a bat found in a privately owned cave in Pike County, and in May of that year on six bats netted outside a public cave in Shannon County (MDC 2012). In Tennessee, the number of confirmed WNS positive counties has doubled between 2011 and 2012 (TNC 2012).

To date, *G. destructans* has not been identified in hibernating bat colonies in Arkansas. Surveys for indications of the disease were conducted on the Sylamore Ranger District during the winter of 2011/2012 and 2012/2013 with help of the Arkansas Game and Fish Commission.

To reduce the possibility that the fungus is spread from equipment or the clothing of individuals entering caves, the Northern and Southern Regions of the US Forest Service have issued closure orders for caves within National Forest managed lands. At this time, only Blanchard Springs Caverns, valued for its recreation and interpretive opportunities, remains open. Blanchard is not known to be used by eastern small-footed bats, although the cave is suitable. Visitors are screened before they attend cave tours to determine if they have potentially visited an affected area. To reduce the risk of human-caused transmission of *G. destructans* into the cave, clothing and items that have been in other caves within the last ten years are not allowed in Blanchard; shoes that may have been worn by visitors in other caves within the last ten years are disinfected prior to the tour. WNS decontamination protocols recognized to be sufficient by the USFWS and AGFC were developed by a multi-agency WNS Decontamination Team and can be found at http://whitenosesyndrome.org/sites/default/files/resource/national_wns_revise_final_6.25.12.pdf. These protocols are currently being followed at Blanchard Springs Caverns.

Potential Effects (Direct and Indirect)

The potential effects of this project are direct effects from felling trees, applying herbicides, and exposure to smoke and heat from prescribed burning. If an undetected population exists in an area undergoing timber harvest, reforestation, or TSI/WSI, it is possible that cutting and felling trees could affect individuals. This species is highly mobile during the active months and are likely to fly and escape any danger, except non-volant young. The timber management actions proposed as part of this project will take place during all seasons with the exception of units where surveys for Indiana bats confirm presence of this species during its active period.

The prescribed burning planned for this project will take place in dormant, early or late growing seasons. Active gestation lasts probably two months, with a single offspring born annually, probably in early July. The timing of the burns will not likely coincide with the birth and presence of non-volant young. Prescribed burning operations will follow Forest Plan standards. The burn will be planned when conditions (such as wind direction and mixing height) make it unlikely that large levels of smoke will come near the caves. Ignition patterns may be adjusted to affect smoke movement while still meeting objectives of the Indiana Bat Habitat Restoration Project.

Cave gate installation may help increase the population of eastern small-footed bats if this species is present in Indiana bat hibernacula proposed for gating in this project. Cave gating will also help protect these bats from white-nose syndrome (WNS) by limiting human to bat transmission of the fungus *Geomyces destructans*.

Alternative 3 would include more growing season burning which could affect the population directly. It is unlikely that this will occur due to the fact that this species is highly mobile during the active months and are likely to fly and escape any danger. It is also possible that this growing season burning will help create more hollow trees or snags which will create more suitable roosting habitat for this species.

Herbicide use as proposed in Alternative 2 would be applied at the lowest effective rate in meeting project objectives. All label instructions and Forest Plan standards and guidelines will be followed. Forest wide standards and site specific analysis will minimize effects to bat species. It is extremly unlikely that bats will come into contact with recently sprayed vegetation due to the timing of emergence for foraging activities.

Cumulative Effects

Timber harvest and non-commercial thinning activities that increase sunlight penetration to the forest floor and prescribed burning will increase the herbaceous plant and insect component which is the prey base for this species. Thinned and burned treatment areas will result in a less cluttered and more open foraging environment. The cumulative effect of Indiana Bat Habitat Restoration Project treatments will improve habitat for Eastern small-footed bats by increasing the prey base for this species and establishing better foraging conditions.

Determination of Effect

This species does occur infrequently within the proposed project area. There will be no loss of or decrease in suitability of habitat for eastern small-footed bats. **Beneficial impacts** will result from the restoration activities in that the thinned and burned treatment areas will provide enhanced foraging habitat. Forest Plan standards will insure retention of at least 9 roosting trees per acre across the entire primary and secondary Indiana bat zones.

Prescribed burning planned for this project would not likely occur at times when non-volant bats would be potentially affected. Adult bats would experience only temporary displacement if disturbed during prescribed burns. Mechanical treatments will not remove known roost trees during the active period. Herbicide use would be applied at the lowest effective rate in meeting project objectives. All label instructions and Forest Plan standards and guidelines will be followed. Therefore, the proposed action alternatives 2 and 3 **may impact individuals but [is] not likely to cause a trend to federal listing or a loss of viability**.

Bald eagle

Environmental Baseline

In 1994, the bald eagle's listing was changed from endangered to threatened in the lower 48 states. Bald eagle numbers in the lower 48 states climbed from 417 nesting pairs in 1963 to more than 4,400 pairs in 1994. In addition, 5,000 to 6,000 juvenile bald eagles live in the lower 48. Federal protection and tremendous public support led to this recovery. Because of the recovery of this species, the U.S. Fish and Wildlife Service has decided to remove the bald eagle from the federally endangered species list, effective August 8, 2007. The Forest Service will continue to protect and monitor this species as a Regional Forester's Sensitive species. The most important recognizable threat to the bald eagle in Arkansas at this time is being shot by poachers. There is also a concern of avian diseases with die-offs occurring on Lake DeGray during the winter of 1994/1995 and 1996/1997 in Arkansas (Thomas, Meteyer and Sileo 1998).

Annual eagle surveys are conducted by the Arkansas Game and Fish Commission in cooperation with the U.S. Fish and Wildlife Service, U.S. Army Corps of Engineers, National Wildlife Federation and the USDA Forest Service. These surveys showed that wintering populations within the state have steadily increased to over 1,000 birds in 1999, nearly triple the 368 recorded in 1979. The first successful bald eagle nesting since 1930 was reported in Arkansas in 1982. In 1995, 18 pairs of Arkansas eagles successfully fledged young from the nest. Arkansas ranks in the top 10 states in the number of winter bald eagle sightings.

Annual eagle nest surveys were conducted on the Sylamore Ranger District between 2000 and 2004 (Wilson 2004). The White River has five known nest sites on private and public lands, two of which are on National Forest land (Cartwright, Whithurst and Wilson, AGFC 2003). An additional nest site near the White River was discovered on National Forest land by S. McCluskey in March, 2011 during an archaeological survey but it is not within the Indiana Bat Habitat Restoration Project area. The most recent Forest Service surveys for bald eagles were conducted in 2004 by Steve Wilson of the AGFC and Rhea Whalen, former Wildlife Biologist for the Sylamore Ranger District. Approximately 11 miles of the White River were surveyed for flying eagles and the two known nest sites on the Sylamore Ranger District were observed. Each nest contained two chicks. This bird is a frequent winter visitor to the District and has been seen along the White River and as far west as State Highway 341.

Potential Effects (Direct and Indirect)

The Bald eagle has not been documented to have roost sites within the Indiana Bat Habitat Restoration Project area. The most important recognizable threat to the Bald eagle in Arkansas at this time is being shot by poachers. There is also a concern of avian diseases with recent die-offs occurring on Lakes Ouachita and Degray in Arkansas.

Bald eagles intermittently using any of the National Forest area would readily move away from any of the treatments. There is quality roosting and foraging habitat all along the White River, which is adjacent to the National Forest. Any displacement from forest management activities would be temporary and would not reduce the area's suitability for roosting, feeding, or its

potential for nesting. Forest Plan standard FW71 will ensure a buffer is observed around any Bald eagle roost or nest sites that may be found. Therefore there will be no direct or indirect effects from the treatments. These statements are true for both Alternative 2 and Alternative 3.

Cumulative Effects
There will be no alteration of known Bald eagle roosting or nesting sites as a result of this project. Therefore there will be no cumulative impacts to the species.

Determination of Effect
If this species is present in an area undergoing treatments they will move to a different foraging and/or roost site on the forest or relocate to the White River adjacent to the forest. The proposed actions will not reduce the area's suitability for the Bald eagle. For these reasons, there will be **no impact** on the Bald eagle from the proposed action alternatives 2 and 3.

Ozark Shiner

Environmental Baseline
The Ozark shiner utilizes portions of large streams and rivers, preferring the high-gradient stream sections below riffles that generate a slight to moderate current. The species is endemic to the Ozark Uplands of northern Arkansas and southern Missouri. It has been found in the White and Black River systems, and a disjunct population in the Illinois River system. The largest populations are found in the Buffalo River. The species is found in several widely scattered populations which seem to have very low densities (Robison 1997).

Within the portion of the White River near the Sylamore District, two areas contain known occurrences. Six records are known from the northwestern portion of the District from the Buffalo and White Rivers at their confluence near Buffalo City. Two additional sites were recorded from the White River on the southeastern portion of the District, at the Mount Olive community five miles upstream from the Highway 5 bridge near the Allison community and approximately 700 feet downstream from the Highway 5 bridge.

Because of the low densities across its range, this species is vulnerable to the loss of populations with no likelihood of reestablishment. NatureServe (2012) states the greatest threat to the species is the destruction, modification, and fragmentation of habitat from the construction of impoundments and associated cold water releases. For those populations on or near the Forest, potential impacts include increases in turbidity, siltation, or altered water flows from management actions on adjacent land. Fragmentation of populations with road crossings or other stream structures could be detrimental given its already apparent low population densities.

Potential Effects (Direct and Indirect)
The majority of impacts from timber harvesting are caused by increased sedimentation from road building activities. This project has only temporary road construction and is limited by design criteria to an annual limit of 10 miles of road reconstruction and 15 miles of road maintenance.

The proposed action is designed to fully incorporate all Forest-wide standards which require use of Best Management Practices (BMPs) which include the use of vegetative filter strips will be applied to the Proposed Action Alternatives 2 and 3. These measures should minimize or eliminate any potential effect due to increased sedimentation from timber harvest and associated road use.

These proposed actions would improve the quality of water yield from the forest over time. The restoration activities will increase the herbaceous plant density on the forest floor. Many of these plant species are long lived perennials with well-developed root systems. These plants contribute to soil stabilization and help to filter sediment out of run-off.

Site preparation, reforestation, release, and non-native invasive plant control treatments would require herbicides. The proposed actions are designed to fully incorporate all Forest-wide standards, and direction specific for herbicide use and limited use of herbicide in SMZs. Given the resource protection measures that minimize herbicide movement into surface waters, there should be no significant effect to the fishery from herbicide use.

Vegetation removed by prescribed fire could slightly increase erosion rates immediately after implementation, but these changes would be very short in duration. Within a few weeks after the growing season begins the area will re-vegetate. Prescribed burn parameters will strongly limit the severity of ecological effects. The result of this type of burning is that in most areas the mineral soil is not bare and has some duff layer left to protect the soil. The primary concern for affecting sedimentation rates during prescribed burns is the associated firelines. The State's BMPs and Forest Plan standards for this activity will minimize the potential effects.

The project contains measures to reduce the potential for sedimentation as a result of prescribed fire control line construction and prescribed burning activities. Mechanical treatment will not affect areas used or adjacent to areas used by the Ozark shiner. Therefore, there will be no potential for direct or indirect impacts to this species.

Cumulative Effects

The impact of activities on private lands in the watersheds where the Ozark shiner is found could have an impact on this species. The proposed actions are limited to forested habitat and will not alter existing or potential habitat required by this species.

Determination of Effect

Observance of streamside management zones (SMZs) will limit sediment contributions and will not alter the flow of the White River. Only herbicides approved for aquatic use will be used to treat non-native invasive plant infestations within the SMZ adjacent to the White River in which this species occurs. Therefore, there will be **no impact** on the Ozark shiner from the proposed action alternatives 2 and 3.

Southern Cavefish

Environmental Baseline
The Southern cavefish inhabits limestone caves in pools and the water of small streams with a rubble or clay bottom. Range-wide it is regarded as relatively stable. It is known from only three caves and one unknown well in Arkansas, but it is more widely-distributed in Alabama, Kentucky, Missouri, and Tennessee. In Arkansas, the species is known from Fulton, Randolph, and Stone County (Romero and Conner 2007). The Stone County locations are from a cave/spring system located partially on the Sylamore District and one on private property.

Potential threats to this species include contamination of ground water or changes in its flow. Karst protection measures should suffice to protect ground water quality for actions on Forest Service managed lands. Actions on public lands around the cave/spring still have the potential to affect the existing known population. The entrance to the cave is on private land, but the land owner has placed a gate across the entrance and is limiting access to what was once a popular recreation cave. The resurgence for the cave is located on Forest Service managed land and is generally protected from recreation pressure. To enter through the spring passage requires diving gear. The recharge area for the cave system was delineated during a study by Ozark Underground Laboratory, Inc. in September 2010 (Aley and Kirkland 2010).

Although the southern cave fish is only known from three caves and one well in Arkansas, the extensive known range of the species indicates that it might be found in other caves in the future. Although the underwater passages for Blanchard Springs Caverns have been searched and the Southern cavefish was not reported, it bears keeping in mind that this was a one-time search and the species might have been overlooked if it was present.

Potential Effects (Direct and Indirect)
Potential threats to this species include contamination of ground water, sedimentation, or changes in its flow. Karst protection measures should suffice to protect ground water quality for actions on Forest Service managed lands. Implementation of Forest Plan standards including karst management zones and will protect any caves that may receive occasional undocumented use.

Site preparation, reforestation, release, and non-native invasive plant control treatments would require herbicides. The proposed actions are designed to fully incorporate all Forest-wide standards related to the conservation of all listed Regional Forester's Sensitive species. Given the resource protection measures that minimize herbicide movement into surface waters, there should be no significant effect to the fishery from herbicide use. Therefore, there will be no potential for direct or indirect impacts to this species.

Cumulative Effects
The impact of activities on private lands in the watersheds where the Southern cavefish is found could have an impact on this species.

Determination of Effect

Implementation of Forest Plan standards including karst management zones and will protect any caves that may receive occasional undocumented use by this species. While herbicides will be used near karst management zones, they will not be used within them. Therefore, there will be **no impact** on the Southern cavefish from the proposed action alternatives 2 and 3.

Nearctic paduneillan caddisfly

Environmental Baseline

This species is endemic to Arkansas and Missouri and is found in creeks to medium-sized rivers. At one time the Arkansas distribution was once thought to occur only in Devils Den State Park, but the distribution was later expanded to cover the 4th level watersheds of Robert S. Kerr Reservoir, Frog-Mulberry, Dardanelle Reservoir, and Little Red. Most recently it has been identified from the Buffalo River National Park (Mott and Laurens 2004) and on the Ozark National Forest at the Barkshed and Blanchard Springs recreation areas (Moulton and Stewart 1996). The distribution of this species has not been extensively studied and its known range continues to expand as collection efforts increase.

This species lives in running water where it makes a tube-shaped retreat of sand, organic matter, and silt that it attaches to rocks and logs. It feeds on periphyton and fine particulate matter around its retreat (Merrit and Cummings 1996). This species is in the family Psychomyiidae, which is known to be intolerant of disturbance. On a scale of 1 to 10 (1= intolerant, 10= tolerant), this family is rated at three.

Because of the family's low tolerance for disturbance, the Nearctic paduneillan caddisfly would likely be affected by siltation. Because caddisflies are terrestrial as adults and able to fly, the Neacrtic paduneillan caddisfly should be able to colonize new available habitat fairly quickly.

Potential Effects (Direct and Indirect)

Because of the family's low tolerance for disturbance, the Nearctic paduneillan caddisfly would likely be affected by siltation. Because caddisflies are terrestrial as adults and able to fly, the Neacrtic paduneillan caddisfly should be able to colonize new available habitat fairly quickly. Projects that comply with Forest Plan standards will give protection to stream and spring habitats that might be utilized by this species. These standards and objectives will prevent degradation of habitat and impacts to this aquatic species.

Both Alternatives involve herbicide applications. The proposed actions are designed to fully incorporate all Forest-wide standards and label directions. Given these resource protection measures that minimize herbicide movement into surface waters, there should be no effect to aquatic species from herbicide use.

The proposed actions alternative 2 and 3 would improve the quality of water yield from the forest over time. The restoration activities will increase the herbaceous plant density on the forest floor. Many of these plant species are long lived perennials with well-developed root systems. These plants contribute to soil stabilization and help to filter sediment out of run-off.

Cumulative Effects
There are private lands adjacent to North Sylamore Creek where this species could be found. The impact of activities on private lands where the Nearctic paduneillan caddisfly is found could have an impact on this species.

Determination of Effect
The proposed action alternatives 2 and 3 **may impact individuals but [is] not likely to cause a trend to federal listing or a loss of viability** on the Nearctic paduneillan caddisfly when considering the potential direct, indirect or cumulative impacts and may also have potentially **beneficial impacts**.

***Lirceus bicuspidatus*, an isopod**

Environmental Baseline
This isopod appears to be endemic to Arkansas (NatureServe 2012). The actual distribution of this species is not well known or understood. It is found in streams and possibly in caves that have moving water. This species has been found on both the Ozark and St. Francis National Forests.

The main impacts to this species seem to be activities that alter habitat or water quality. This could occur from the use of chemicals, dam construction, stream alterations, or sediment increases. Populations on or near the Ozark-St. Francis National Forests would be most susceptible to impacts from management activities like pesticide use and fire retardant use as well as logging, road construction, cattle grazing, burning, and over abundant recreational use at stream crossings that cause large amounts of siltation.

Potential Effects (Direct and Indirect)
Projects that comply with Forest Plan standards and objectives will give protection to stream and spring habitats that might be utilized by this species. These standards and objectives will prevent degradation of habitat and impacts to this aquatic species.

Both Alternatives involve herbicide applications. The proposed actions are designed to fully incorporate all Forest-wide standards and label directions. Given these resource protection measures that minimize herbicide movement into surface waters, there should be no effect to aquatic species from herbicide use.

The proposed actions alternative 2 and 3 would improve the quality of water yield from the forest over time. The restoration activities will increase the herbaceous plant density on the forest floor. Many of these plant species are long lived perennials with well-developed root systems. These plants contribute to soil stabilization and help to filter sediment out of run-off.

Cumulative Effects

The impact of activities on private lands in the watersheds where this isopod is found could have an impact on this species.

Determination of Effect
The proposed action alternatives 2 and 3 **may impact individuals but [is] not likely to cause a trend to federal listing or a loss of viability** on the isopod *L. bicuspidatus* when considering the potential direct, indirect or cumulative impacts and may also have potentially **beneficial impacts**.

Ozark chinquapin

Environmental Baseline
In general, the Ozark chinquapin is most common in dry, upland deciduous or mixed hardwood-pine communities although it can also be found on mesic sites. It prefers more open or thinly wooded conditions, such as are found adjacent to ravines, the tops of sandstone bluffs, and woods edges. However, this species has been decimated throughout its range by the chestnut blight (*Cryphonectria parasitica*) an introduced fungus. As a result, very few large trees exist. Rather, it can most often be seen as small trees or saplings repeatedly coming up from stump sprouts with very few surviving to seed-bearing age. Ozark chinquapin is very common on the Sylamore District.

Chestnut blight is the major threat to this species. However, field observations indicate that Ozark chinquapin, despite infection, can be expected to hold its own in competition with other tree species in almost all kinds of disturbance factors resulting from normal forest management practices (Tucker 1989). Timber and fire management activities which create open conditions would benefit Ozark chinquapin if individuals did not succumb to the pathogen. These activities may still benefit this species in the long-run. By opening the canopy, stump sprouts are more likely to receive enough sunlight to maintain their root systems. If they can persist long enough in this way, an antidote to the chestnut blight may be found in time to revive the species. Natural fire regimes were known to maintain mid-successional forests in which this species could thrive. Loss of the natural fire regime has led to successional change that has negatively affected regeneration and growth (NatureServe 2012). The Forest Plan states that for projects involving herbicides, trees should be identified and avoided during herbicide application.

Potential Effects (Direct and Indirect)
Timber and fire management activities which create open conditions would benefit Ozark chinquapin if individuals did not succumb to the pathogen. These activities may still benefit this species in the long-run. By opening the canopy, stump sprouts are more likely to receive enough sunlight to maintain their root systems. If they can persist long enough in this way, an antidote to the chestnut blight may be found in time to revive the species. Natural fire regimes were known to maintain mid-successional forests in which this species could thrive (NatureServe 2012).

However, some risk of impacting individual trees does exist. Prescribed burning during the dormant season poses little risk to trees, but burning conducted during the growing season may damage or kill individual trees if there is piled fuel nearby or if they occur in areas where there is a hot uphill run of fire. The presence of cankers on the lower trunk may also make individual trees more susceptible to heat damage from prescribed burning.

There is a chance of damaging or killing individuals during the construction of firelines and temporary roads or mechanical treatment. Firelines will utilize existing roads and streams where practical. The use of hand tools and leaf blowers will not affect Ozark chinquapin. During mechanical treatments, because an operator has limited ability to select trees for shredding and the equipment can be difficult to maneuver, there is potential that the above ground portions of Ozark chinquapin trees will be damaged or destroyed in these areas. Mechanical treatments will not occur on slopes >35%.

Both Alternatives involve herbicide applications. Adherence to Forest Plan standard FW28 will ensure this action does not affect populations of listed plant species.

Although individual trees may be affected in local areas, the species is common throughout the District and benefits from open conditions that will be created by the proposed thinning and prescribed burning in alternative 2 and 3. Root systems are also known to persist and resprout even when above-ground portions of the tree succumb to canker, are mechanically destroyed, or burned during the dormant season.

Cumulative Effects
Considering that the species is so widespread on the District, the effects of canker which occur regardless of management activity, and the species' ability to resprout, the proposed restoration activities will not be contributing to cumulative effects to the species.

Determination of Effect
The proposed action alternatives 2 and 3 **may impact individuals but [is] not likely to cause a trend to federal listing or a loss of viability** for Ozark chinquapin.

Southern lady's slipper

Environmental Baseline
The Southern lady's slipper prefers rich, moist floodplains along larger creeks and rich, moist slopes. The species occurs in a relatively narrow range from northeastern Texas and southeastern Oklahoma east to Georgia and northward into Kentucky. Approximately 100-200 occurrences are believed extant (about 100 confirmed extant and 100 not yet assessed). Approximately half of these occurrences are in Arkansas, with significant numbers in Kentucky, Tennessee, and Louisiana as well, and the remainder scattered throughout the rest of range. An additional 19 occurrences are considered historical or extirpated. In Arkansas, it is known from 20 counties (NatureServe 2012) mostly located in the western portion of the state.

Southern lady's slipper is a large, showy plant and unfortunately it is sought after by collectors for commercial sale. This appears to be the biggest range-wide threat to the plant. It is able to tolerate timber management, with some treatments, such as thinning, being beneficial. However those activities that take place during the growing season may damage the above-ground vegetation or top-kill the plant. Because this species is limited to mesic habitats, backing fires, such as occur during prescribed burning, are unlikely to reach and damage plants. Feral hogs may also uproot and consume roots- conceivably decimating populations.

Determination of Effect

Extensive field surveys in potentially suitable habitat have been conducted but the Southern lady's slipper has never been found on the Sylamore District. It has also not been encountered in adjacent counties (ANHC 2010). For these reasons it is not expected to occur on the Sylamore Ranger District. Therefore, there will be **no impact** to Southern lady's slipper from the proposed action alternatives 2 and 3.

Newton's larkspur

Environmental Baseline

Newton's larkspur is also known as Moore's larkspur. This species is endemic to and locally abundant in two disjunct regions of the Interior Highland regions of Arkansas. It is not known from either Missouri or Oklahoma. It occurs in five counties in the Ozark Mountains (Johnson, Newton, Pope, Searcy, and Van Buren) and three counties in the Ouachita Mountains (Polk, Montgomery and Pike) (NatureServe 2012). Data indicates that it is widespread within a small area of the Ozark NF on the Big Piney Ranger District occurring in moist, loamy soils under the shade of mature and successional vegetation types. It has not been found on the Sylamore District.

Newton's larkspur "prefers light to heavy shade of hardwoods, a moist loamy clay or sandy clay loam" (Kral 1983), and also occurs on sites having at least some pine in the overstory, and along roads, trails, and openings in forested areas.

Potential Effects (Direct and Indirect)

At most locations, Newton's larkspur grows within forest communities that have been managed for timber harvest in the past. Some of the largest populations appear to have been high-graded for commercial timber harvest (probably on multiple occasions). The species appears to grow best (i.e. vigorous colonies containing plants of all age groups) on sites that have experienced thinning or canopy alteration through selective harvest. A population on the Ozark NF is known to exist on a mesic site having extremely heavy shade under old trees. Plants have persisted at that site throughout the last 35 years, but the population has been extremely small during that period. Observations made at a few additional sites with similar conditions suggest that the species is not as vigorous under excessive shade conditions as on sites having less shade.

Because canopy thinning appears to result in more hearty populations, management activities that allow more sunlight to reach the forest floor have the potential to benefit Newton's larkspur.

These activities, such as burning, herbicide application, and timber harvest, do, however, have the potential to negatively impact populations as well. Conducting these activities during the growing season could trample or kill above ground portions of the plant. Total canopy removal resulting from regeneration harvest activities or any burn that is hot enough to remove large amounts of organic material from the soil's surface may dry out the site making it unsuitable for Newton's larkspur. Prescribed burn parameters will strongly limit the severity of ecological effects that are detrimental to the viability of this species. Because it typically occurs in mesic habitats, there is limited potential for prescribed fire to carry. These sites are typically buffered from fire effects except in extreme wildfire circumstances.
Both Alternatives involve herbicide applications. Adherence to Forest Plan standard FW28 will ensure this action does not affect populations of listed plant species.

Cumulative Effects
There will be no cumulative effects to Newton's larkspur because it is not present on the district.

Determination of Effect
Extensive field surveys in potentially suitable habitat have been conducted but Newton's larkspur has never been found on the Sylamore District (ANHC 2010). Therefore, there will be **no impact** to Newton's larkspur from the proposed action alternatives 2 and 3.

Glade larkspur

Environmental Baseline
According to Smith (1988) this species is endemic to southwestern Missouri and northwest Arkansas. It occurs on limestone glades and bald knobs in the White River region and on rocky open limestone exposures and glades elsewhere. This plant is relatively common within its limited range although it is no longer tracked as a rare species in Missouri. In Arkansas, it is limited to the north and northwest counties, including Marion, Baxter and Stone Counties. Approximately 80 occurrences are known range-wide with 18 of those located on the Ozark National Forest. Two records are known from the Sylamore Ranger District. One is located in the northwestern portion of the district west of Advance; the other is located in northern Stone Co. within the Cole Fork drainage.

Population trends are largely unknown since only recently have significant inventories been taken (NatureServe 2012). No additional populations were found during recent glade assessments on the Sylamore District by The Nature Conservancy (Zollner 2011 to present). Many of the remaining populations in this species range are small, perhaps indicating a reduction in habitat quality. Habitat loss due to development and degradation will likely lead to long-term declines in the species.

Loss of the natural fire regime and the encroachment and proliferation of eastern red cedar (*Juniperus virginiana*) and other woody plants have become a severe threat to glade larkspur habitat, and the most likely negative impact on the Forest as development does not occur. Prescribed fire and thinning to remove cedar from suitable sites would directly benefit this

species. Herbicide application is a threat to extant populations if applied to the plant while it is active. Those sites along rights-of-way may be particularly vulnerable.

Potential Effects (Direct and Indirect)
Prescribed burns during the dormant season will not injure plants, but may be limited in their beneficial effects because these burns typically do not reduce the amount of under- and midstory. Growing season burns may kill above-ground portions of plants but because they will take place under controlled conditions, they will not likely burn hot enough to kill the roots.

Both Alternatives involve herbicide applications. Adherence to Forest Plan standard FW28 will ensure this action does not affect populations of listed plant species.

Cumulative Effects
There is very little risk of cumulative effects from negatively affecting populations of these species if they are present in burned areas, and results may be beneficial. The potential beneficial cumulative effects to the species during glade restoration activities will come from removing eastern red cedar during WSI treatments and prescribed burning activities that kill eastern red cedar and allow more sunlight to penetrate the ground in the glade habitat where this species occurs. If this species is present in a location overcrowded by non-native invasive plants, it is possible that there will be beneficial cumulative effects due to the reduction of competition for suitable habitat.

Determination of Effect
The proposed action alternatives 2 and 3 will have a mix of potentially **beneficial effects** and **may impact individuals but [is] not likely to cause a trend to federal listing or a loss of viability** for Glade larkspur.

Open-ground draba

Environmental Baseline
Open-ground draba, also known as open-ground whitlow-grass, is known from eleven Arkansas counties, including Benton, Cleburne, Faulkner, Garland, Madison, Montgomery, Polk, Pope, Saline, Stone, and Washington (NatureServe 2012). It is known from one location on the District and it has the potential to occur within the many glades found in the area. No additional populations were found during recent glade assessments on the Sylamore District by The Nature Conservancy (Zollner 2011 to present).

This species grows in thin soils or on rocky outcrops, generally in soils too thin to support a continuous cover of large trees. Thus it is exposed to at least partial sun. It also does not tolerate much competition due to limited available moisture. Because it does not compete well against other plants it may be easily displaced by invasive species (NatureServe 2012). Large areas of rock outcrops may provide a persistent location for this species, but smaller sites may be impacted by encroachment and forest succession.

Glades in which this species occurs would benefit from vegetative manipulation including prescribed burning or thinning that would keep the canopy open. Herbicide should be applied with care in areas where this plant is present to avoid negative impacts.

Potential Effects (Direct and Indirect)
Prescribed burns during the dormant season will not injure plants, but may be limited in their beneficial effects because these burns typically do not reduce the amount of under- and midstory. Growing season burns may kill above-ground portions of plants but because they will take place under controlled conditions, they will not likely burn hot enough to kill the roots.
Both Alternatives involve herbicide applications. Adherence to Forest Plan standard FW28 will ensure this action does not affect populations of listed plant species.

Cumulative Effects
There is very little risk of cumulative effects from negatively affecting populations of these species if they are present in burned areas, and results may be beneficial. The potential beneficial cumulative effects to the species during glade restoration activities will come from removing eastern red cedar during WSI treatments and prescribed burning activities that kill eastern red cedar and allow more sunlight to penetrate the ground in the glade habitat where this species occurs. If this species is present in a location overcrowded by non-native invasive plants, it is possible that there will be beneficial cumulative effects due to the reduction of competition for suitable habitat.

Determination of Effect
The proposed action alternatives 2 and 3 will have a mix of potentially **beneficial effects** and **may impact individuals but [is] not likely to cause a trend to federal listing or a loss of viability** for Open-ground draba.

Butternut

Environmental Baseline
This species ranges from New Brunswick Canada to North Dakota, south to Georgia and Arkansas. Range-wide habitat for this species is described as rich woods on lower slopes and along streams. It is a shade intolerant species. Reproduction can only be sustained in stand openings or fields where shade cannot impede its development. Young trees may withstand competition from the side, but will not survive shade from above.

On the District, this species does not appear to be restricted to these moist, rich habitats; it has been seen in a variety of sites including dry ridgetops, bluffs and along creeks. Butternut has been mostly located on the east side of the District near the White River and in the southwest portion of the District in the Roasting Ear area during field surveys (E. Hendrix 2005). It appears to be most abundant near Sneed's Creek in Compartment 12.

Butternut is being killed throughout its range by *Sirocuccus clavigignenti-juglandacearum*, a fungus most likely introduced from outside North America. This fungus causes butternut canker.

It was first reported from southwestern Wisconsin in 1967; the disease has contributed to as much as an 80 percent decrease in living butternut is some states. The fungus initially infects trees through buds, leaf scars, and possibly insect wounds or other openings in the bark. Small branches are rapidly killed, and the spores produced there are carried down the stem by rain, resulting in multiple, perennial stem cankers that eventually girdle and kill the infected tree. Butternut is a relatively short-lived tree, and stress from old age and competition often leads to root diseases, decay, infection by other fungi, and invasion by wood boring insects, resulting in tree death unrelated to butternut canker (USDA 1996).

Potential Effects (Direct and Indirect)
Without an effective treatment for butternut canker and disease, there is very little that can be done to actively preserve trees or manage suitable habitat. Maintaining open conditions in existing butternut sites may aid in natural reproduction, but seedling growth will not outpace infection and resulting death.

Both Alternatives involve herbicide applications. Adherence to Forest Plan standard FW28 will ensure this action does not affect populations of listed plant species.

Prescribed burning may take place during the dormant or growing season. The burns will be designed to meet objectives for the Indiana Bat Habitat Restoration Project and avoid damage to large trees but there is a chance that individuals could be damaged or killed during a growing season burn while the sap is running in the tree's cambium. If there is piled fuel near a butternut tree or a pocket of fire races up a slope where a butternut tree is growing, the increased heat could damage or kill the tree. These conditions would be uncommon, and when combined with the conditions under which the burns will be conducted, the risk of this happening is low.

Cumulative Effects
Butternut trees within thinned or burned units may cumulatively benefit from more open conditions which improves regeneration and may make the conditions less favorable for the fungus that affects the trees.

Determination of Effect
Based on the rationale above, the proposed action alternatives 2 and 3 **may impact individuals, but [is] not likely to cause a trend to federal listing or a loss of viability** for Butternut.

Ovate leaf catchfly

Environmental Baseline
The range for this species is from Virginia south and west to Georgia, Alabama, Mississippi, and northern Arkansas. The plant is primarily restricted to the Appalachian physiographic province. In Arkansas, this species is found in Baxter, Cleburne, Crawford, Newton, Pope, Stone, and Van Buren Counties. It is possibly extirpated from Benton and Carroll Counties (NatureServe 2012).

Typical habitat for this species is rich woods over well-drained soils, often with a sandy or rocky component (NatureServe 2012). Suitable habitat may include talus slopes beneath sandstone blufflines. Stunted populations might benefit from creating more open conditions to allow sunlight to reach the forest floor. Prescribed fire and thinning may benefit these sites if done in a manner that does not permanently dry out the forest floor or if conducted during the dormant season of the plant to avoid top killing the vegetation. However genetic diversity may be a problem in some populations and may cause inevitable decline (NatureServe 2012). Three sites have been recorded on the Sylamore District: along the White River near Cartney in Baxter County; along the bluffs at City Rock Bluff and Blanchard Springs in Stone County. No additional populations were found during recent glade assessments on the Sylamore District by The Nature Conservancy (Zollner 2011 to present).

Potential Effects (Direct and Indirect)
Mechanical treatments, timber harvest and associated actions, and temporary road and fireline construction have the potential to uproot and kill plants. It is unlikely that temporary roads developed for timber sales will be constructed in rich woods habitat as timber units are typically restricted to upper slopes and ridgetops. Roads and streams will be used as fireline where possible to reduce the amount of fireline that will need to be constructed. Leaf blowers and hand tools will be used near riparian or other sensitive areas to further reduce the potential for impacts. The locations of temporary roads and firelines will be approved by Forest Service resource specialists before construction so that potential impacts to sites will be reduced or eliminated.

Prescribed burns during the dormant season will not injure plants, but may be limited in their beneficial effects because these burns typically do not reduce the amount of under- and midstory. Growing season burns may kill above-ground portions of plants but because they will take place under controlled conditions, they will not likely burn hot enough to kill the roots. Based on these factors there may be a mix of potentially beneficial and unfavorable effects of the proposed actions.

Both Alternatives involve herbicide applications. Adherence to Forest Plan standard FW28 will ensure this action does not affect populations of listed plant species.

Cumulative Effects
There is very little risk of cumulative effects from negatively affecting populations of these species if they are present in burned or mechanically treated areas, and results may be beneficial.

Determination of Effect
Based on this mix of potentially beneficial and unfavorable effects, the proposed project **may impact individuals, but [is] not likely to cause a trend to federal listing or a loss of viability** for the Blue Ridge catchfly.

Royal Catchfly

Environmental Baseline

Royal catchfly is a Midwestern endemic of tall grass prairie habitats. It has relatively few and scattered populations which are most abundant in Missouri. It is considered extirpated from Kansas and Tennessee, and is considered quite rare in all other states within its range. In Arkansas this species is known from Benton, Boone, Bradley, Hot Springs, Newton, Searcy, Sharp, Stone, and Washington Counties. There are very few known locations for this plant on Forest Service managed lands. Five sites with royal catchfly are known from the District; all are located within the Spring Creek vicinity in Searcy County outside of the Indiana Bat Habitat Restoration Project area (Hyatt 2008). No additional populations were found during recent glade assessments on the Sylamore District by The Nature Conservancy (Zollner 2011 to present).

The major threat to this species is habitat destruction through agricultural practices. Prairies are no longer extensive in the Midwest and this plant is now found principally along roadsides where prairie vegetation still occurs. These populations are vulnerable to construction or changes in management of roadside vegetation, including untimely mowing, herbicide use, or encroachment of woody plants. The natural fire regime, once effective at maintaining open areas suitable for this species, has not occurred for well over a century. Increased shade levels have reduced the reproductive vigor of some extant populations.

On the District glades or rocky outcrops could offer optimal habitat with rocky areas alongside roads providing secondary habitat. Periodic disturbances (fire, shrub removal, etc.) may need to be implemented to reduce woody vegetation and may provide favorable conditions for seedling establishment. Management techniques which thin the overstory (e.g. timber harvest or prescribed fire) could have beneficial effects on populations or suitable habitat as plants appear smaller and produce fewer flowers when in the shade.

Potential Effects (Direct and Indirect)

Prescribed burns during the dormant season will not injure plants, but may be limited in their beneficial effects because these burns typically do not reduce the amount of under- and midstory. Growing season burns may kill above-ground portions of plants but because they will take place under controlled conditions, they will not likely burn hot enough to kill the roots. Based on these factors there may be a mix of potentially beneficial and unfavorable effects of the proposed actions.

Mechanical thinning treatments will also have a mix of potentially beneficial and unfavorable effects. It is possible that unknown plants could be damaged during implementation of treatments; however, the thinning will open the overstory and allow more sunlight and less competition.

Both Alternatives involve herbicide applications. Adherence to Forest Plan standard FW28 will ensure this action does not affect populations of listed plant species.

It is unlikely that the proposed actions alternative 2 and 3 will directly or indirectly affect this species because it is not known to occur in the project area.

Cumulative Effects
There is very little risk of cumulative effects from negatively affecting populations of these species if they are present in burned or mechanically treated areas, and results may be beneficial.

Determination of Effect
Based on this mix of potentially beneficial and unfavorable effects, the proposed project **may impact individuals, but [is] not likely to cause a trend to federal listing or a loss of viability** for the Royal catchfly, if it occurs in the project area.

Ozark spiderwort

Environmental Baseline
This plant is endemic to the Ozark and Ouachita Mountains. There are 15 extant populations in Missouri, more than that in Arkansas, and a few in Oklahoma. Ozark spiderwort has been recorded at numerous sites scattered over the western half of the Ozark National Forest. It has been found in Baxter, Benton, Carroll, Johnson, Logan, Marion, Newton, Polk, Pope and Scott Counties in Arkansas but it is possibly extirpated in Marion, Polk and Scott Counties (NatureServe 2012). Throughout its range it has been recorded from rich, diverse, but mainly deciduous woodlands especially on limestone soils. Seven sites are located in the northern portion of the District outside of the Indiana Bat Habitat Restoration Project area. No additional populations were found during recent glade assessments on the Sylamore District by The Nature Conservancy (Zollner 2011 to present).

Range-wide it is considered relatively secure and does not appear to be highly habitat-specific. The species is considered relatively secure despite some documented declines due to construction of dams. Potential threats include development and herbicide use. It appears tolerant of various levels of light and disturbance. Succession of habitat may also threaten populations by shading out individuals (Smith 1992 in NatureServe 2012).

Potential Effects (Direct and Indirect)
Intermediate timber treatments could be beneficial to this plant by opening up the forest floor and improving growth conditions. Regeneration harvests and silvicultural practices, as well as warm season prescribed burning would eliminate most of the canopy and could adversely impact the species if they were actively growing at the time of disturbance by either top killing the plant or by opening the forest floor too much, which would allow for drying the site and indirectly impacting habitat. Prescribed burns during the dormant season will not injure plants, but may be limited in their beneficial effects because these burns typically do not reduce the amount of under- and midstory enough. Growing season burns may kill above-ground portions of plants but because they will take place under controlled conditions, they will not likely burn hot enough to kill the roots. Based on these factors there may be a mix of potentially beneficial and unfavorable effects of the proposed actions.

Mechanical treatments, timber harvest, and temporary road and fireline construction have the potential to uproot and kill plants. It is unlikely that temporary roads developed for timber sales

will be constructed in rich woods habitat as timber units are typically restricted to upper slopes and ridgetops. Roads and streams will be used as fireline where possible to reduce the amount of fireline that will need to be constructed. Leaf blowers and hand tools will be used near riparian or other sensitive areas to further reduce the potential for impacts. The locations of temporary roads and firelines will be approved by Forest Service resource specialists before construction so that potential impacts to sites will be reduced or eliminated.

Both Alternatives involve herbicide applications. Adherence to Forest Plan standard FW28 will ensure this action does not affect populations of listed plant species.

Cumulative Effects
There is very little risk of cumulative effects from negatively affecting populations of these species if they are present in burned or mechanically treated areas, and results may be beneficial.

Determination of Effect
Based on this mix of potentially beneficial and unfavorable effects, the proposed project **may impact individuals, but [is] not likely to cause a trend to federal listing or a loss of viability** for the Ozark Spiderwort, if it occurs in the project area.

Ozark least trillium

Environmental Baseline
Ozark least trillium is known to occur only in Missouri and in nine western Arkansas counties, primarily lying in the northern part of the state. This species occurs in acid cherty-flint soils of shallow draws in oak-hickory, oak-pine, or oak-chestnut woodland in the Ozark region. It also occurs on limestone glades and bald knobs in the White River region.

Populations are generally stable and appear to be able to tolerate some disturbance although some have been lost to water impoundments and urban development (NatureServe 2012). Timber harvest may be beneficial or adverse depending on the amount of canopy removed. Thinning the forest canopy to increase light levels could be beneficial, while clearcutting would impact existing populations. Optimum habitat appears to include a partially open canopy (NatureServe 2012). Populations would also be impacted by herbicide treatment, or prescribed fire during the growing season. A wildfire at a Missouri site during the dormant season did not appear to adversely affect the population.

District documents indicate that this species may occur on Forest Service managed lands. The Biological Evaluation for the proposed Sylamore Prescribed Burning Projects for FY 2005-2010 states that three sites are known on the District, but records could not be found as having the plant. A report has circulated about a population near Blanchard Springs introduced by a local individual, Edith Huey. The former District Biologist contacted an associate of Mrs. Huey's who said that she had relocated plants that were going to be impacted or destroyed by a road relocation project, but these were not Ozark least trilliums, and no plants were planted on the National Forest. This was confirmed by Karen Tinkle, former District Biologist. No populations

were found during recent glade assessments on the Sylamore District by The Nature Conservancy (Zollner 2011 to present).

Potential Effects (Direct and Indirect)
Intermediate timber treatments could be beneficial to this plant by opening up the forest floor and improving growth conditions. Regeneration harvests and silvicultural practices, as well as warm season prescribed burning would eliminate most of the canopy and could adversely impact the species if they were actively growing at the time of disturbance by either top killing the plant or by opening the forest floor too much, which would allow for drying the site and indirectly impacting habitat. Prescribed burns during the dormant season will not injure plants, but may be limited in their beneficial effects because these burns typically do not reduce the amount of under- and midstory enough. Growing season burns may kill above-ground portions of plants but because they will take place under controlled conditions, they will not likely burn hot enough to kill the roots. Based on these factors there may be a mix of potentially beneficial and unfavorable effects of the proposed actions.

Mechanical treatments, timber harvest, and temporary road and fireline construction have the potential to uproot and kill plants. Roads and streams will be used as fireline where possible to reduce the amount of fireline that will need to be constructed. Leaf blowers and hand tools will be used near riparian or other sensitive areas to further reduce the potential for impacts. The locations of temporary roads and firelines will be approved by Forest Service resource specialists before construction so that potential impacts to sites will be reduced or eliminated.

Both Alternatives involve herbicide applications. Adherence to Forest Plan standard FW28 will ensure this action does not affect populations of listed plant species.

Cumulative Effects
There is very little risk of cumulative effects from negatively affecting populations of these species if they are present in burned or mechanically treated areas, and results may be beneficial.

Determination of Effect
Based on this mix of potentially beneficial and unfavorable effects, the proposed project **may impact individuals, but [is] not likely to cause a trend to federal listing or a loss of viability** for the Ozark least trillium, if it occurs in the project area.

Ozark cornsalad

Environmental Baseline
Approximately 40 sites occur across a small geographic range in Missouri, Oklahoma, and Arkansas. Ozark cornsalad is found in Benton, Carrol, Conway, Madison, Searcy, and Stone Counties in Arkansas. Its habitat is described as sunny openings in deciduous woods, sandstone and limestone glades, and roadside ditches. A population is located in Blanchard Springs Recreation Area. No additional populations were found during recent glade assessments on the Sylamore District by The Nature Conservancy (Zollner 2011 to present).

The main threats to this species include fire suppression, natural succession, the use of herbicides and fertilizers, the loss of refuges along field margins, and the introduction of extremely competitive crop plants.

Potential Effects (Direct and Indirect)
Prescribed burns during the dormant season will not injure plants, but may be limited in their beneficial effects because these burns typically do not reduce the amount of under- and midstory. Growing season burns may kill above-ground portions of plants but because they will take place under controlled conditions, they will not likely burn hot enough to kill the roots. Based on these factors there may be a mix of potentially beneficial and unfavorable effects of the proposed actions.

Timber management and prescribed burning would improve habitat for this species by opening the forest canopy and promoting the growth of early seral plant communities in which Ozark cornsalad is able to thrive. Mechanical treatments in glade habitats would also improve habitat for this species.

Both Alternatives involve herbicide applications. Adherence to Forest Plan standard FW28 will ensure this action does not affect populations of listed plant species.

Cumulative Effects
There is very little risk of cumulative effects from negatively affecting populations of these species if they are present in burned areas, and results may be beneficial. If this species is present in a location overcrowded by non-native invasive plants, it is possible that there will be beneficial cumulative effects due to the reduction of competition for suitable habitat.

Determination of Effect
Based on this mix of potentially beneficial and unfavorable effects, the proposed project **may impact individuals, but [is] not likely to cause a trend to federal listing or a loss of viability** for the Ozark cornsalad.

Prepared by:

/s/ Jessica Wakefield 03 April 2013

Jessica Wakefield Date
Zone Wildlife Biologist
Sylamore and St. Francis Ranger Districts
Ozark-St. Francis National Forests

Literature Cited

Aley, Thomas and Shiloh L. Kirkland. 2010. Groundwater Recharge Area Delineation And Vulnerability Mapping of the Clark Springs/Alexander Cave Stone County, Arkansas. Ozark Underground Laboratory Inc. Unpublished survey data.

Arkanas Native Plant Society. 2005. Claytonia: Newsletter of the Arkansas Native Plant Society, volume 25, no. 2, p. 1.

Arkansas Natural Heritage Commission. 2010. Rare Species Search Engine. http://www.naturalheritage.com/research-data/rarespecies-search.aspx Accessed October 30, 2010.

Arkansas Natural Heritage Commission. 2007. Database. Plant and animal EORS within Forest Service Administrative Boundaries.

Cartwright, M., Y.D. Whithurst, and Steve Wilson, AGFC. 2003. Communication, records and maps of known Bald Eagle nest sites on the White River. Mountain View, AR.

Harvey, Michael J. 1979-2006. Reports to the Ark. Game and Fish, U.S. Forest Service of the Status of Endangered Bats on the Sylamore Ranger District. Report produced by Ecological Research Center, Department of Biology, Memphis State University, Memphis, Tennessee.

Hendrix, Earl. 2005. USFS. Unpublished field notes.

Hyatt, Phil 2008. Report on the discovery of two sites for *Silene regia*. June 24, 2008. 11 pages.

Kral, Robert. 1983. A Report on Some Rare, Threatened or Endangered Forest Vascular Plants of the South, Technical Publication R8-TP 2.

Menzel, Michael A., Jennifer Menzel, Tmothy Carter, W. Mark Ford, John W. Edwards. 2001. Review of the forest habitat relationship of the Indiana bat (Myotis sodalis). Gen. Tech. Rep. NE-284. Newton Square, Pennsylvania: USDA, Forest Service, Northeastern Research Station. 21 pp.

Merritt, R. W. and K. W. Cummins. 1996. An Introduction to the Aquatic Insects of North America. Kendall/Hunt Publishing Company, Dubuque, Iowa. 862 pp.

MDC 2012. "Three cases of bat disease discovered in Missouri". Missouri Department of Conservation online http://mdc.mo.gov/newsroom/three-cases-bat-disease-discovered-missouri accessed January 2, 2013.

Mott, D. N. and J. Laurens. 2004. Water Resource Management Plan: Buffalo National River, Arkansas. USDI, National Park Service, Buffalo National River, Harrison, Arkansas. 160 pp.

Moulton, S. R. II and K. W. Stewart. 1996. Memoirs of the American Entomological Institute: Caddisflies (Trichoptera) of the Interior Highlands of North America. Volume 56. The American Entomolofical Institute, Gainesville, Florida. 313 pp.

NatureServe. 2012. NatureServe Explorer: An online encyclopedia of life [web application]. Version 7.1 NatureServe, Arlington, Virginia. Available http://www.natureserve.org/explorer.

Redman, Ron and Blake Sasse. 2006 to present. Endangered bat monitoring on the Sylamore Ranger District. Unpublished field notes.

Risch, Tom. 2004 to present. Indiana bat compliance surveys on the Sylamore Ranger District. Unpublished field notes.

Robison, H.W. 1997. Distribution and Status of the Ozark Shiner, *Notropis ozarcanus* Meek, in Arkansas. Journal of the Arkansas Academy of Science Vol. 51, 1997.

Romero, Aldemaro and Michel Conner. 2007. Status Report for the Southern Cavefish, *Typhlichthys subterraneus* in Arkansas. Department of Biological Sciences Arkansas State University. State Wildlife Grant Project Report.

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

TNC 2012. Holliday, C. 2012 White-nose Syndrome Disease Surveillance and Bat Population Monitoring Report: A Repot of the Tennessee WNS Response Cooperators. Tennessee Chapter of the Nature Conservancy. July 2012 accessed @ http://www.caves.org/WNS/TN%202012%20White%20Nose%20Syndrome%20Report.pdf January 2, 2013.

Thomas, N. J., C. U. Meteyer and L. Sileo. 1998. Epizootic Vacuolar Myelinopathy of the Central Nervous System of Bald Eagles (*Haliaeetus leucocephalus*) and American Coots (*Fulica americana*). Vetrinary Pathology 1998 35: 479.

Tucker, Gary E. 1989. Draft Interim Management Guide for Ozark Chinquapin (*Castanea pumila var. Ozarkensis*). Ozark-St. Francis National Forests. Mounatin View, Arkansas.

USDA Forest Service 2011a. SERA TR 052-22-03b and SERA TR-052-22-03a-App. Forest Health Protection. Glyphosate: Human Health and Ecological Risk Assessment Final Report and Appendices. Syracuse Environmental Research Associates. www.fs.fed.us/foresthealth/pesticide/risk.shtml

USDA Forest Service. 2011b. SERA TR 052-29-03a. Forest Health Protection. Imazapyr: Human Health and Ecological Risk Assessment Final Report. Syracuse Environmental Research Associates. www.fs.fed.us/foresthealth/pesticide/risk.shtml

USDA Forest Service 2011c. SERA TR 052-25-03a and SERA TR-052-25-03a-App. Forest Health Protection. Triclopyr: Human Health and Ecological Risk Assessment Final Report and Appendices. Syracuse Environmental Research Associates. www.fs.fed.us/foresthealth/pesticide/risk.shtml

USDA Forest Service. 2005a. Revised Land and Resource Management Plan, Ozark-St. Francis National Forests. Available at http://www.fs.usda.gov/land/osfnf/landmanagement.

USDA Forest Service. 2005b. Final Environmental Impact Statement for the Revised Land and Resource Management Plan, Ozark-St. Francis Naitoanl Forests, Arkansas.

USDA Forest Service. 2004. Field notes, reports from Center For Aquatic Technology Transfer's (CATT) survey of North Sylamore, Bad Branch, Stewart, Cole and Cap Fork Creeks. Mountain View, Arkansas.

USDA Forest Service. 2004. Field notes, reports, monitoring records referenced in the Biological Evaluation for the "Sylamore Prescribed Burning Projects For FY 2005- 2010", Mountain View, Arkansas.

USDA Forest Service. 2003. Field notes, report, pictures, etc. from the "Rosson Hollow Prescribed Burning Smoke Contaminant Monitoring" by R.Odegard and M. Caviness, Ozark-St. Francis National Forest, Boston Mountain Ranger District, Ozark, Arkansas.

USDA Forest Service 1996. How to Identify Butternut Canker and Manage Butternut Trees, North Central Forest Experimental Station; Northeastern Area, S&PF; and Region 8 S&PF.

USFWS. 2011. A National Plan for Assisting States, Federal Agencies, and Tribes in Managing White-Nose Syndrom in Bats. Accessed at http://whitenosesyndrome.org/ on November 29, 2012.

USFWS 2009. White-nose syndrome in bats: Frequently Asked Questions.

USFWS 2007. Bald Eagle Haliaeetus leucocephalus. Endangered Species Program. Arlington,

VA. 2 pp.

Wilson, Steve. 2004. Personal communication from S. Wilson, AGFC to Rhea Whalen, USFS Biologist.

WNS decontamination protocols http://whitenosesyndrome.org/sites/default/files/resource/national_wns_revise_final_6.25.12.pdf.

Zollner, Douglas. 2011 to present. The Nature Conservancy. Draft Ecological Assessment of Glades on the Eastern Portion of the Sylamore Ranger District. Unpublished field data and communication to Jessica Wakefield, USFS Biologist.

APPENDIX D:

SOIL

Damage by Fire and Seedling Mortality on Forestland

Stone County, Arkansas

[The information in this table indicates the dominant soil condition but does not eliminate the need for onsite investigation. The numbers in the value columns range from 0.01 to 1.00. The larger the value, the greater the potential limitation. The columns that identify the rating class and limiting features show no more than five limitations for any given soil. The soil may have additional limitations. This report shows only the major soils in each map unit]

Map symbol and soil name	Pct. of map unit	Potential for damage to soil by fire		Potential for seedling mortality	
		Rating class and limiting features	Value	Rating class and limiting features	Value
3:					
Clarksville	100	Low		Low	
4:					
Clarksville	100	Low		Low	
5:					
Clarksville	60	Low		Low	
Nixa	30	Moderate		Low	
		Texture/surface depth/rock fragments	0.50		
8:					
Elsah	95	Moderate		Low	
		Texture/rock fragments	0.50		
9:					
Enders	100	Low		Low	
12:					
Estate	30	Low		Low	
Moko	30	Low		Low	
Portia	30	Moderate		Low	
		Texture/rock fragments	0.50		
13:					
Estate	40	High		Low	
		Texture/slope/surface depth/rock fragments	1.00		
Moko	20	Moderate		Low	
		Texture/slope/rock fragments	0.50		
Portia	20	Moderate		Low	
		Texture/rock fragments	0.50		

Forestland Planting and Harvesting

Stone County, Arkansas

[The information in this table indicates the dominant soil condition but does not eliminate the need for onsite investigation. The numbers in the value columns range from 0.01 to 1.00. The larger the value, the greater the potential limitation. The columns that identify the rating class and limiting features show no more than five limitations for any given soil. The soil may have additional limitations]

Map symbol and soil name	Pct. of map unit	Suitability for hand planting		Suitability for mechanical planting		Suitability for use of harvesting equipment	
		Rating class and limiting features	Value	Rating class and limiting features	Value	Rating class and limiting features	Value
3:							
Clarksville	100	Moderately suited		Poorly suited		Well suited	
		Rock fragments	0.50	Rock fragments	0.75		
				Slope	0.50		
4:							
Clarksville	100	Moderately suited		Unsuited		Moderately suited	
		Slope	0.50	Slope	1.00	Slope	0.50
		Rock fragments	0.50	Rock fragments	0.75		
5:							
Clarksville	60	Moderately suited		Poorly suited		Well suited	
		Rock fragments	0.50	Rock fragments	0.75		
				Slope	0.50		
Nixa	30	Well suited		Moderately suited		Well suited	
				Slope	0.50		
				Rock fragments	0.50		
8:							
Elsah	95	Well suited		Moderately suited		Moderately suited	
				Rock fragments	0.50	Low strength	0.50
Aquents	5	Not rated		Not rated		Not rated	
		Not rated		Not rated		Not rated	
		Not rated		Not rated		Not rated	
9:							
Enders	100	Moderately suited		Moderately suited		Moderately suited	
		Stickiness; high plasticity index	0.50	Stickiness; high plasticity index	0.50	Low strength	0.50
				Rock fragments	0.50		
				Slope	0.50		
12:							
Estate	30	Moderately suited		Moderately suited		Well suited	
		Stickiness; high plasticity index	0.50	Slope	0.50		
				Stickiness; high plasticity index	0.50		
				Rock fragments	0.50		

Haul Roads, Log Landings, and Soil Rutting on Forestland

Stone County, Arkansas

[The information in this table indicates the dominant soil condition but does not eliminate the need for onsite investigation. The numbers in the value columns range from 0.01 to 1.00. The larger the value, the greater the potential limitation. The columns that identify the rating class and limiting features show no more than five limitations for any given soil. The soil may have additional limitations]

Map symbol and soil name	Pct. of map unit	Limitations affecting construction of haul roads and log landings		Suitability for log landings		Soil rutting hazard	
		Rating class and limiting features	Value	Rating class and limiting features	Value	Rating class and limiting features	Value
3:							
Clarksville	100	Moderate		Poorly suited		Severe	
		Stickiness/slope	0.50	Slope	1.00	Low strength	1.00
4:							
Clarksville	100	Severe		Poorly suited		Severe	
		Slope	1.00	Slope	1.00	Low strength	1.00
5:							
Clarksville	60	Moderate		Poorly suited		Severe	
		Stickiness/slope	0.50	Slope	1.00	Low strength	1.00
Nixa	30	Slight		Poorly suited		Severe	
				Slope	1.00	Low strength	1.00
8:							
Elsah	95	Severe		Poorly suited		Severe	
		Flooding	1.00	Flooding	1.00	Low strength	1.00
		Low strength	0.50	Low strength	0.50		
Aquents	5	Not rated		Not rated		Not rated	
		Not rated		Not rated		Not rated	
		Not rated		Not rated		Low strength	1.00
		Not rated					
		Not rated					
		Not rated					
9:							
Enders	100	Moderate		Moderately suited		Severe	
		Low strength	0.50	Low strength	0.50	Low strength	1.00
12:							
Estate	30	Slight		Poorly suited		Severe	
				Slope	1.00	Low strength	1.00
Moko	30	Severe		Poorly suited		Moderate	
		Stoniness	1.00	Slope	1.00	Low strength	0.50
		Restrictive layer	1.00	Low strength	0.50		
Portia	30	Slight		Poorly suited		Severe	
				Slope	1.00	Low strength	1.00

Hazard of Erosion and Suitability for Roads on Forestland

Stone County, Arkansas

[The information in this table indicates the dominant soil condition but does not eliminate the need for onsite investigation. The numbers in the value columns range from 0.01 to 1.00. The larger the value, the greater the potential limitation. The columns that identify the rating class and limiting features show no more than five limitations for any given soil. The soil may have additional limitations]

Map symbol and soil name	Pct. of map unit	Hazard of off-road or off-trail erosion		Hazard of erosion on roads and trails		Suitability for roads (natural surface)	
		Rating class and limiting features	Value	Rating class and limiting features	Value	Rating class and limiting features	Value
3:							
Clarksville	100	Slight		Moderate		Poorly suited	
				Slope/erodibility	0.50	Slope	1.00
4:							
Clarksville	100	Moderate		Severe		Poorly suited	
		Slope/erodibility	0.50	Slope/erodibility	0.95	Slope	1.00
5:							
Clarksville	60	Slight		Moderate		Poorly suited	
				Slope/erodibility	0.50	Slope	1.00
Nixa	30	Slight		Moderate		Poorly suited	
				Slope/erodibility	0.50	Slope	1.00
8:							
Elsah	95	Slight		Slight		Poorly suited	
						Flooding	1.00
						Low strength	0.50
Aquents	5	Not rated		Not rated		Not rated	
		Not rated		Not rated		Not rated	
		Not rated		Not rated		Not rated	
		Not Rated		Not rated			
		Not rated		Not rated			
				Not Rated			
9:							
Enders	100	Slight		Moderate		Moderately suited	
				Slope/erodibility	0.50	Low strength	0.50
12:							
Estate	30	Slight		Moderate		Poorly suited	
				Slope/erodibility	0.50	Slope	1.00
Moko	30	Slight		Severe		Poorly suited	
				Slope/erodibility	0.95	Slope	1.00
						Low strength	0.50
Portia	30	Slight		Severe		Poorly suited	
				Slope/erodibility	0.95	Slope	1.00

APPENDIX E

2007 Ozark-St. Francis National Forests Herbicide Monitoring Plan

Herbicide Monitoring Plan for Water Quality, Ozark-St. Francis National Forests

Introduction
This monitoring plan, upon authorization, is to replace all previous instruction issued by the Ozark-St. Francis prior to FY 2007 for compliance monitoring of herbicide use post application. This document details practices which are considered a minimum for meeting monitoring requirement. Implementation will need to address project specific needs that may arise from scoping, or unique use situation considering the specifications are not less stringent and fully documented in project records.

Purpose
This monitoring program serves as validation/compliance monitoring for the offsite movement of applied herbicides for typical silviculture uses and invasive plant eradication. The Forest has a history of glyphosate and triclopyr monitoring, but little information for other common chemicals now or expected to be in use. This program is designed to address issues surrounding offsite movement of pesticides via surface water and potential surface water contamination. This plan focuses solely on water soluble herbicides; chemicals with different properties *will require* a modified sampling protocol and coordinated through the Supervisors Office staff.

This plan is currently approved for the following pesticides: Glyphosate, Triclopyr, Imazypyr, Sulfometuron-Methyl, 2,4-D, Picloram, Fluridone, Hexazinone.

Herbicides are one of the management tools used on the OSFNF to control competing vegetation. Common uses include applications designed to maintain wildlife openings, eradicate NNIS, control grass or weeds, and eliminate unwanted trees from a stand's composition. The primary use is for site preparation and timber stand improvement.

When herbicides are applied there is an acknowledged risk that herbicides could be spilled, misapplied, and/or move offsite. Practices are predicated by standing policies to insure that herbicides are properly applied. The Forest Service has specific regulations for the transport, storage, use and applications of herbicides and the OSFNF has additional standards or required guidelines. These can be found in the FSH 1909.14, FSM 2150 (Pesticide Use Policy), FSM 2153.3 (Pesticide Use Safety), FSH 2109.14, FSH 6709.11, FSH 6709.12 (Additional Health and Safety information), FSM 2150-OZ Supplement 2100-2150-1, Revised LRMP FW 19 – FW 32 (pages 3-4 to 3-5), and Arkansas Forestry Best Management Practices for Water Quality Protection Section 7 – Forest Chemicals.

The principle best management practice to prevent off-site movement of herbicides is the requirement to leave an untreated buffer in place along water courses and private lands. The practice is spelled out in the Revised LRMP FW-32 (page 3-5), which states that herbicide should not be applied within 50 or 100 feet of any stream, sinkhole, lake or wetland as determined by FW-43 and FW-81.

When all the BMPs and regulations are followed, there should be little to no significant offsite movement of herbicide (Michael, 2004). With respect to water quality, contamination of water might be significant if it occurs in such quantities that it poses a threat to human health, aquatic organisms, or exceeds state, federal, or local water quality standards.

Objective

Herbicide applications are monitored to ensure the effectiveness of BMPs as necessary mitigations to protect water quality, and to validate any presumptions made regarding the levels of herbicide concentrations in forest water courses. Herbicides moving offsite in high enough quantities to pose a threat to human health, aquatic organism, or non-target vegetation would indicate improper application procedures, inappropriate prescriptive uses of herbicides and/or necessitate a review of mitigation measures utilized by the forest. Herbicide concentrations in water courses above those expected or with values large enough to contribute to the degradation of water quality would indicate a need to evaluate the specifics surrounding the particular project to determine if policy or practice changes are necessary.

Selection Process

Each district is required to conduct monitoring following the application of either glyphosate or triclopyr on an annual basis. All applications of other pesticide chemicals or mixtures will be subjected to monitoring requirements. Any pesticide spill that occurs as a result of forest service activities will also be monitored for deleterious effects. If substantial issues surround the use of pesticides for a particular project, monitoring in excess of this amount is strongly encouraged.

Use the following criteria to select projects for monitoring:
The treated area is above a domestic or public water intake.
The area is adjacent to private land, campground, or other area with a potential for public contact.
A fishery is located near the area or the area borders a perennial stream.

Once a project is identified for monitoring, sample sites need to be selected. Sites must include a water course in proximity to the treated unit. Sites should be as close as practical to the treated areas. Sites should be located to incorporate multiple upstream application units. Sites must allow access without going through the treated area.

An appropriate number of monitoring sites needs to be selected in order to sample 20 percent of the project area, with a minimum of one monitoring site. If 174 acres are treated, the sampling must include 35 acres where application occurred. If the project consisted of 7 spot treatments along a roadside for kudzu, then 2 application areas need to be sampled.

Sample collection

Sample bottles, labels, latex gloves, and shipping materials will be provided by the SO. Material needs should be anticipated by the district well in advance of their use and requested prior to application activities. Plastic bottles capable of holding 500 ml of liquid material are the preferred sample collection and storage containers.

Two samples and duplicates should be taken at each site. The first sample (and duplicate) should be taken as soon as possible during, or after the first rainfall of ½ inch or more. If the site is dry, then it should be noted in the monitoring file and revisited during subsequent precipitation. The second sample (and duplicate) should be collected for the subsequent storm or runoff period (based on a 24 hour cycle).

If private lands or other treatment units exist upstream, a control should also be taken above the treatment unit selected for monitoring. Controls will not be necessary in all cases. If necessary, control sites should be sampled immediately upstream of the first encountered treatment unit. Control samples do not require a duplicate; therefore take one control sample prior to each downstream sample.

A typical sampling program on a stream that flows through private land would consist of 6 samples. These samples include 2 downstream samples plus duplicates (4 total), plus 2 control samples. The 1st and 2nd downstream samples are shipped for analysis, while any controls and duplicates are stored in the freezer until results are returned from the lab and evaluated. Prior to disposal of these samples contact the forest pesticide coordinator to ensure that they are no longer needed.

The person taking the sample should be a forest certified stream sampler, and free from contact with herbicide. If the sampler has inspected the area or even used the inspector's truck, contamination is possible. The sampler should enter the site so as not to cross the treated area or an area where herbicides have been stored, transported, prepared or mixed.

Latex gloves should be worn when the sample is taken. The sampler should approach from downstream and take the sample from the center of the channel. If flows are sufficient, the sample bottle should be lowered in the stream and the lid removed. If possible, collect the sample from below the surface of the water.

Fill the bottle within an inch of the top and screw the lid on tight. Do not fill the bottle completely full so that expansion due to freezing is accounted for. Complete the label information. Repeat the label information on the side of the bottle with a permanent marker.

Place the sample on ice and freeze the sample upon return from the field.

Sample Numbering

To maintain consistency over the forest, samples should be numbered to include district, compartment, stand number, and sample number in that order. The sample number should appear as 1a and 1b for the first sample and its duplicate, 2a and 2b for the second sample and its duplicate. Control samples should be labeled as C1, and C2. A sample from the Magazine would look similar to this: 06 362 014 1a (district, compartment, stand number, and sample number)

Sample storage
Freeze all samples upon return to the station. This will preserve the samples until they are ready to ship to the laboratory. This preservation method was verified by personnel at A&L Great Lakes Laboratory.

Shipping
Ship each sample within a week of collection. If several samples are collected within a week, they can be shipped together to save money on shipping. Do not store samples over a week, with the exception of duplicates and controls. When sample(s) are ready for shipment, package the frozen samples in a disposable Styrofoam container, provided by the SO. Utilize newspapers or packaging peanuts and frozen ice packs to secure the shipment inside the container.

The 1st and 2nd samples should be sent for analysis. The duplicate samples and the control samples will remain frozen until the results from the lab are known. The duplicates and any corresponding control samples will be analyzed if the primary sample indicates excessive levels of off site movement. For example, if the second sample (sample 2a) tests positive and the other samples are negative, only duplicate sample 2b and control number 2 (C2) will be sent for testing. Duplicate one and control one will be saved until the results are provided to the Forest and evaluated.

Samples should be sent to:

APT Labs Inc., 1050 Spring Street, Reading, PA, 19610 1-610-375-3888

Reporting/Billing
When samples are collected, fill out the enclosed "Herbicides Sampling Record" form for each sample and forward the form to the SO. Please forward a *copy* of the chain of custody report to the forest coordinator as well. All chain of custody information should be included in the shipping containers in a waterproof bag. If the samples are being sent to APT Labs, or A and L Great Lakes Laboratory also complete the particular chain of custody form for the respective labs and include that inside the packaging as well.

The laboratory will send test results to the SO where records will be compiled. Upon receipt of the results, a copy will be promptly forwarded to the districts.

The bill for the analysis will be sent to the Forest Silviculturist and is to be paid for via purchase card. If the herbicide application is part of an SAI plan, KV funds will pay for the costs. If the application is a non-SAI plan project then the respective job code will be used. The districts will be responsible for payment of the shipping costs. If three or more samples are submitted at any one time, or a mixture of herbicides is used, the costs may exceed the purchasing limit for credit cards and thus should be coordinated with the SO prior to submission.

Follow up

It is expected that there will be some level of herbicide detected in any sample, thus each sample result will be reviewed by the SO to determine if the levels are acceptable. This is determined by chemical used, application methods, specific project related goals, and NEPA documentation disclosure. If it is determined that excessive or environmentally deleterious amounts of off site movement occurred, the district, together with the Forest hydrologist and Forest silviculturist will review the situation.

Reference

Michael, J.L., 2004, Best Management Practices for Silvicultural chemicals and the Science behind them, Water, soil, and air pollution: focus, vol. 4, p. 95-117.

APPENDIX F:

Key Regulated Pollutants and Their Significance in Smoke

Key Regulated Pollutants and their Significance in Smoke

Fine Particulates ($PM_{2.5}$)

Particulate is a term used to describe dispersed airborne solid and liquid particles which will remain in atmospheric suspension from a few seconds to several months. Particulates that remain suspended in the atmosphere are efficient at light scattering and therefore contribute to visibility impairment. Very small particles can travel great distances and contribute to regional haze problems. Regional haze can result from prescribed burning over multiple days and/or multiple owners utilizing the air shed over too short a period of time. Cumulative particulate load may be the result of prescribed burning only, or urban and industrial sources only, or it may be a combination of the two. The causes of regional haze are often difficult to identify. Total suspended particulates (TSP) include all suspended particulates, no matter the size. Particulate matter less than 2.5 microns in diameter ($PM_{2.5}$), or less than 10 microns in diameter (PM_{10}) describes particles small enough to enter the human respiratory system. Fires emit large amounts of fine particulate matter that can impact human health and impair visibility.

Particulate matter, alone or in combination with other pollutants, can constitute a health hazard. Particulates enter the body mainly via the respiratory system. Particulate matter may exert a toxic effect in one or more of the following ways:

1. The particle may be intrinsically toxic because of its chemical and/or physical characteristics.

2. The particle may interfere with one or more of the mechanisms which normally clear the respiratory tract.

3. The particle may act as a carrier of an absorbed toxic substance.

Medical studies have shown a solid relationship between increases in particulate concentrations and rises in the number of clinic and hospital visits for upper respiratory infections, cardiac diseases, bronchitis, asthma, pneumonia, and emphysema. Deaths of elderly persons afflicted with respiratory diseases and cardiac conditions also show an increase during periods when the concentration of particulate matter is unusually high for several days.

Some recent studies have indicated that urban particulate matter may be more dangerous to human health than rural particulate. There is speculation that urban pollution sources, like auto exhaust and industrial sources may be more toxic than rural sources, such as dust or wood smoke. This theory has not yet been proven definitively.

There are few studies which evaluate the toxicity of forest fire smoke. Almost all investigations of the toxicity of smoke particulate matter in human populations have been conducted with particulates associated with burning coal or fossil fuels where sulfur oxides and sulfates are the

important constituents. However, these chemicals are not generated in a significant quantity by vegetation fires.

Sulfur Dioxide

Sulfur dioxide (SO_2) is emitted primarily from combustion of fuel containing sulfur; generally either coal or oil. Sulfur compounds are also emitted naturally by marine sources, soils and vegetation, volcanoes, and geothermal activity. Humans respond to sulfur dioxide exposure with an increase in airway resistance. Most individuals show a response to SO_2 at concentrations of 5 ppm (parts per million) and above and certain sensitive individuals show slight effects at 1 to 2 ppm. Excess SO_2 in the atmosphere also effects sensitive vegetation.

Sulfur dioxide can also contribute to reduction in visibility. Atmospheric haze is caused by the formation of various aerosols resulting from the photochemical reactions between SO_2, particulate matter, oxides of nitrogen, and hydrocarbons in the atmosphere. Sulfur dioxide transforms into an acid when absorbed in cloud water and raindrops and can fall as acid rain.

Most forest fuels contain less than 0.2 percent sulfur so sulfur oxides could be produced only in negligible quantities during prescribed fires and wildfires.

Carbon Monoxide

Carbon monoxide (CO) is produced by automobile exhaust and other incomplete combustion sources. Carbon monoxide is a poisonous inhalant that deprives the body tissues of necessary oxygen. Extreme exposure (>750 ppm) can cause death. Impaired time-interval discrimination can occur when humans are exposed to concentrations as low as 10 to 15 ppm for 8 hours. Carbon monoxide exposure can also result in central nervous system effects such as impairment of visual acuity, brightness discrimination, and psychomotor functions. Symptoms include headache, fatigue, and drowsiness.

Large quantities of carbon monoxide are emitted from wildfire and prescribed fires. Carbon monoxide exposure from these sources can be significant for fire line workers but CO dilutes very rapidly in the atmosphere and probably is not a concern to urban and rural areas even a short distance downwind. One study measured CO concentrations as high as 200 ppm close to flames but observed that the concentration was reduced to less than 10 ppm just 100 feet from the fire.

Ozone

Ozone is a secondary pollutant formed from the reaction of volatile organic compounds with oxides of nitrogen in the presence of sunlight. Volatile organic compounds originate from industrial processes, solvent use, and transportation. The origin of nitrogen oxides is discussed in another section. Ozone can cause eye, nose, and throat irritation, and chest constriction in humans at concentrations above 0.10 ppm.

On vegetation, ozone can cause visible injury, reduced photosynthetic capacity, increased respiration, premature leaf senescence, and reduced growth. Other effects include alteration of carbon allocation, greater susceptibility to environmental stress, changes in plant community composition, and loss of sensitive genotypes from a population.

Prescribed fires and wildfires emit volatile organic compounds (VOCs) which can react with urban sources of nitrogen to form ozone. Elevated ozone levels have been measured at the top of smoke plumes. Elevated ozone in cities far downwind from wildfires has been attributed in part to wildfire emissions.

Nitrogen Dioxide

Oxides of nitrogen are formed in a combustion process when nitrogen in the air or in fuel combines with oxygen at elevated temperatures. Nitrogen dioxide acts as an acute irritant. Some increase in bronchitis in children has been observed at concentrations below 0.01 ppm. In combination with hydrocarbons, oxides of nitrogen react in the presence of sunlight to form photochemical smog or ozone. Nitrogen dioxide absorbs visible light and at a concentration of 0.25 ppm will cause appreciable reduction in visibility.

Formation of nitrogen oxides occur at temperatures not normally found in prescribed fires. Some oxides of nitrogen may be formed at lower temperatures in the presence of free radicals, and nitrogenous compounds in forest fuels are another possible source. Generally, wild land fire is considered an insignificant contributor of these emissions.

Lead

The principal source of lead emissions is the combustion of gasoline containing lead alkyl additives. Since use of leaded gasoline has decreased dramatically, lead air pollution is rarely a problem anymore.

Lead particles that have been deposited on vegetation over decades can become re-emitted if the vegetation is burned. This phenomenon was documented during chaparral burning which took place east of the Los Angeles basin.

Ambient Air Quality Standards for pollutants pertinent to prescribed burning projects.

Pollutant	Primary Standards		Secondary Standards	
	Level	Averaging Time	Level	Averaging Time
Carbon	9 ppm	8-hour [(1)]	None	

Monoxide	(10 mg/m^3)			
	35 ppm (40 mg/m^3)	1-hour [1]		
Lead	0.15 µg/m^3 [2]	Rolling 3-Month Average	Same as Primary	
Nitrogen Dioxide	53 ppb [3]	Annual (Arithmetic Average)	Same as Primary	
	100 ppb	1-hour [4]	None	
Particulate Matter (PM_{10})	150 µg/m^3	24-hour [5]	Same as Primary	
Particulate Matter ($PM_{2.5}$)	15.0 µg/m^3	Annual [6] (Arithmetic Average)	Same as Primary	
	35 µg/m^3	24-hour [7]	Same as Primary	
Ozone	0.075 ppm (2008 std)	8-hour [8]	Same as Primary	
	0.08 ppm (1997 std)	8-hour [9]	Same as Primary	
	0.12 ppm	1-hour [10]	Same as Primary	
Sulfur Dioxide	0.03 ppm [11] (1971 std)	Annual (Arithmetic Average)	0.5 ppm	3-hour [1]
	0.14 ppm [11] (1971 std)	24-hour [1]		
	75 ppb [12]	1-hour	None	

[1] Not to be exceeded more than once per year.
[2] Final rule signed October 15, 2008. The 1978 lead standard (1.5 µg/m^3 as a quarterly average) remains in effect until one year after an area is designated for the 2008 standard, except that in areas designated nonattainment for the 1978 standard, the 1978 standard remains in effect until implementation plans to attain or maintain the 2008 standard are approved.
[3] The official level of the annual NO_2 standard is 0.053 ppm, equal to 53 ppb, which is shown here for the purpose of clearer comparison to the 1-hour standard
[4] To attain this standard, the 3-year average of the 98th percentile of the daily maximum 1-hour average at each monitor within an area must not exceed 100 ppb (effective January 22, 2010).
[5] Not to be exceeded more than once per year on average over 3 years.
[6] To attain this standard, the 3-year average of the weighted annual mean PM2.5 concentrations from single or multiple community-oriented monitors must not exceed 15.0 µg/m^3.
[7] To attain this standard, the 3-year average of the 98th percentile of 24-hour concentrations at each population-oriented monitor within an area must not exceed 35 µg/m^3 (effective December 17, 2006).
[8] To attain this standard, the 3-year average of the fourth-highest daily maximum 8-hour average ozone concentrations measured at each monitor within an area over each year must not exceed 0.075 ppm. (effective May 27, 2008)

[9] (a) To attain this standard, the 3-year average of the fourth-highest daily maximum 8-hour average ozone concentrations measured at each monitor within an area over each year must not exceed 0.08 ppm.

(b) The 1997 standard—and the implementation rules for that standard—will remain in place for implementation purposes as EPA undertakes rulemaking to address the transition from the 1997 ozone standard to the 2008 ozone standard.

(c) EPA is in the process of reconsidering these standards (set in March 2008).

[10] (a) EPA revoked the 1-hour ozone standard in all areas, although some areas have continuing obligations under that standard ("anti-backsliding").

(b) The standard is attained when the expected number of days per calendar year with maximum hourly average concentrations above 0.12 ppm is $\leq$ 1.

[11] The 1971 sulfur dioxide standards remain in effect until one year after an area is designated for the 2010 standard, except that in areas designated nonattainment for the 1971 standards, the 1971 standards remain in effect until implementation plans to attain or maintain the 2010 standards are approved.

[12] Final rule signed June 2, 2010. To attain this standard, the 3-year average of the 99th percentile of the daily maximum 1-hour average at each monitor within an area must not exceed 75 ppb.

Source: http://epa.gov/air/criteria.html

APPENDIX G:

Insects and Diseases Affecting Hardwood and Pine Species

Information in this appendix was provided by Saul D. Petty, Entomologist, USDA Forest Service, State and Private Forestry, Region 8, Forest Health Protection, Pineville, LA for the *2009 Ice Storm Hazardous Fuels Reduction Project*

Insects and Diseases Affecting Hardwood Species

Organism	General Description	Potential Response No Action	Potential Response to Management Actions
Hypoxylon canker (*Hypoxylon atropunctatum*, AKA *Biscogniauxia atropuctata var. atropunctata)*	Mostly saprophytic sapwood rotter that aggressively colonizes dead and dying tissues of oaks and hickories. Generally abundant.	*Hypoxylon* canker would increase proportionally with the increase in dead/dying hardwood material. Long-term health of injured trees could be slightly compromised as the organism colonized dead/dying or stressed tissues. May contribute to a slight increase in dead/dying branches and limbs.	*Hypoxylon* canker would potentially be reduced by removal of damaged or merchantable timber. Benefits to the remaining trees would be minimal. Prescribed burning would have little direct affect on *Hypoxylon* canker unless additional trees were killed or severely wounded making them susceptible to infection/colonization.
Armillaria root disease (*Armillaria* spp.)	A nearly ubiquitous root decay organism of hardwoods and conifers; particularly prevalent on oaks and hickories in the Ozarks. A component of the oak decline syndrome; it is often resident in root systems of even healthy trees but responds to stress-induce physiological changes by aggressively advancing and colonizing large roots up to the root collar and butt. Significantly contributes to tree mortality.	*Armillaria* would increase significantly, particularly in trees that were root-sprung and leaning and in other trees under severe stress from crown loss, bole splitting, etc. Armillaria would hasten and increase tree mortality.	Effects of *Armillaria* would be somewhat reduced by the removal of damaged timber since stress trees would be less prevalent after treatment. Prescribed burning would have little affect on *Armillaria* since the fungus operates in subterranean roots adequately insulated from fire affects. If trees were damaged or stressed by overly-intense fires, *Armillaria* and its affects could increase slightly.
Oak wilt	Oak wilt is a rather uncommon,	Oak wilt might increase slightly	Oak wilt would probably not

(*Ceratocystis fagacearum*)	tree-killing wilt disease of red oaks in Arkansas. White oaks are rarely significantly affected. Normal means of spread is due to Nitidulid sap beetles carrying the fungus from infected trees with sporulating fungal structures to healthy trees (by feeding on sappy, wounded areas).	due to the abundance of wounds for contaminated sap beetles to feed on. However, due to the relative infrequency of oak wilt infection loci, this increase would be very small.	increase except, perhaps, if timber harvest created wounds in tree limbs/boles. Such wounds, however, would likely be proportionally very small compared to wounding by the storm (but would be fresher) such that a slight increase in disease might occur.
Oak Decline	Oak decline syndrome is a rather slow-to-develop phenomenon which results in dieback and mortality of oaks and hickories. Older stands on moderate to low-productivity sites, often on ridgetops are most susceptible. Short term acute drought or other stress can initiate a decline event. Secondary pests such as Armillaria root rot, wood borers exacerbate the situation and contribute to dieback and mortality.	Oak decline may increase somewhat due to the stress from ice storm damage in susceptible trees.	Harvesting and prescribed burning would mitigate the potential effects of decline slightly be removing many of the trees under the most severe stress.
Red Oak Borer (*Enaphalodes rufulus*)	A large wood boring beetle, the ROB can permanently and severely damage the wood of infested oaks. The borers also facilitate the entry of other wood degrading insects into the tree. These insects do not infest woody debris. [Donley et al. 1980]	Remaining trees that have suffered damage will be more susceptible to ROB attack though the threat of a substantial infestation will depend on other factors.	Removal of damaged trees will lessen the potential for ROB infestation.
Ambrosia Beetles, Oak	These insects are generally	Very minimal threat of	Very minimal threat of becoming

bark beetle, Hickory bark beetle, 2-lined chestnut borer, Carpenterworm, White oak borer	considered minimal threats and are common in the forest.	becoming a pest.	a pest.

Insects and Diseases Affecting Pine Species

Organism	General Description	Potential Response No Action	Potential Response to Management Actions
Ips Engraver Beetle (*Ips* spp.)	*Ips* beetles usually attack weakened, dying, or recently felled trees and fresh logging debris. Large numbers *Ips* may build up when natural events such as lightning storms, ice storms, tornadoes, wildfires, and droughts create large amounts of pine suitable for the breeding of these beetles. [Connor et al. 1983]	The presence of suitable brood material will facilitate a population increase which will put surrounding live trees at risk.	Mechanical removal of damaged trees and debris along with prescribed fire will decrease the potential for Ips infestations. However, if remaining live trees are further damaged by these activities the beetles may cause additional tree mortality or damage.
Black Turpentine Beetle (*Dendroctonus terebrans*)	Attacks from this beetle may be associated with low tree vigor resulting from drought, flooding or severe stand disturbances caused by mechanized logging. Freshly cut stumps are usually preferred for breeding, whereas freshly cut logs are rarely attacked. The beetle also shows a preference for weakened trees, such as those damaged by fire, or infested by other bark beetles; but it is capable of attacking apparently	These beetles usually present a minimal threat but may become a problem in snapped off or otherwise broken trees.	As with Ips beetles, any activity that puts further stress on the trees and creates fresh, attractive host material may result in additional infestations. Care should be taken when removing material from the woods.

	healthy trees. [Smith et al. 1972]		
Southern Pine Beetle (*Dendroctonus frontalis*)	Rarely if ever occur in the affected area. Worthy of mention due to presence of desired host and favorable infestation conditions.	Very minimal threat of becoming a pest.	Very minimal threat of becoming a pest.
Ambrosia Beetles	These beetles are generally considered secondary insects and are very common.	Very minimal threat of becoming a pest.	Very minimal threat of becoming a pest.
Annosus root rot (*Heterobasidion annosum)*	Annosum root rot is a common, fungal disease which can cause mortality in thinned pine stands on deep sandy, well-drained soils.	Annosum could increase slightly in stands with a substantial number of down trees where broken and damaged roots are exposed to infection.	Thinning or partially harvesting pines in damaged stands poses a risk for the introduction of annosum into stands where it was not already present. Treating cut stumps with borate formulations on high-risk soils will prevent severe colonization.
Brown Cubical Root rot (*Polyporus schweinitzii)*	This common root and butt rot operates on the larger roots, root collar and lower bole of pines creating large sections of brown cubical rot.	This rot could increase due to root damage and wounding from the ice storm. Development would be slow and it would be years before any significant decay development would be apparent.	Any increase in decay from this organism might be slightly mitigated by harvesting damaged trees. Burning would likely have little to no effect unless residual trees were damaged by overly hot burns.
Red heart disease *(Fomes pini)*	Red heart is a decay disease which is normally prevalent only in very old stands. It enters the tree through branch stubs and is favorable to the development of red-cockaded woodpeckers.	Red heart might increase slightly due to the abundance of broken or dead branches following the ice storm.	Removal of damaged trees might slight decrease the development of red heart in the residual stand. Burning should have little to no effect.

Time Frame
Insect and disease damage can appear immediately and persist for many years or manifest gradually with delayed impact on the tree. Environmental conditions often facilitate damage from these agents and a combination of many factors may eventually kill a tree. Prescribed fire and mechanical removal of damaged trees will serve to lessen the impact of these agents.

Safety Concerns
One of the more serious consequences of insect and disease damage is the creation of hazard trees. In addition to the physical damage caused by the storm event, the continued degradation of damaged trees will increase the risk to people using recreation facilities, trails, roads and the forest in general. Removal of damaged trees in campgrounds, recreational areas, and other high-use areas will decrease the risks to the public.

Sanitation Activities
If insect and disease problems are allowed to become established and increase, it may become necessary to perform sanitation activities in the damage area. The factors that determine the necessity of such activities vary greatly depending on the pest and current environmental conditions. If problems are observed a decision should be made on a site specific basis in line with established control practices. While the need for sanitation activities should be minimal, it is important to anticipate the possibility and prepare accordingly.

References
Alexander, S.A.; Anderson, R.L. 1985. How-to: identify and control annosus root rot in the South. Forestry Bulletin R8-FB/P 19. Atlanta, GA: United States Department of Agriculture, Forest Service, Southern Region. Pamphlet.

Anderson, R.L.; Price, T.; Tainter, F.H. 1995. How to identify and control Hypoxylon cankers of oaks and other hardwoods. Protection Report R8-PR 29. Atlanta, GA: United States Department of Agriculture, Forest Service, Southern Region. Pamphlet.

Barry, P.J.; Doggett, C.; Anderson, R.L.; Swain, K.M. 1998. How to evaluate and manage storm-damaged forest areas. Management Bulletin R8-MB-63. Atlanta, GA: United States Department of Agriculture, Forest Service, Southern Region. 11p.

Connor MD, Wilkinson RC. 1983. Ips Bark Beetles in the South. Pineville (LA): USDA Forest Service Forest Health Protection. Forest Insect and Disease Leaflet No. 129.

Smith RH, Lee RE III. 1972. Black Turpentine Beetle. Berkley (CA): USDA Forest Service Pacific Southwest Research Station. Forest Insect & Disease Leaflet No. 12.

Donley DE, Acciavatti RE. 1980. Red Oak Borer. Delaware (OH): USDA Forest Service Northeastern Forest Experiment Station. Forest Insect and Disease Leaflet No. 163

O'Brien, J.G.; Mielke, M.E.; Starkey, D.A.; Juzwik, J. 2000. How to identify, prevent, and control oak wilt. NA-PR-03-00. 28p.

Rexrode, C.O.; Brown, D. 1983. Oak Wilt. Forest Insect & Disease Leaflet 29. Washington, DC: United States Department of Agriculture, Forest Service.

Starkey, D.A.; Oak, S.W.; Ryan, G.W.; Tainter, F.H.; Redmond, C.; Brown, H.D. 1989. Evaluation of oak decline areas in the South. Protection Report R8-PR-17. Atlanta, GA: United States Department of Agriculture, Forest Service, Southern Region. 36p.

Wargo, P.M.; Houston, D.R.; LaMadeleine, L.A. 1983. Oak Decline. Forest Insect & Disease Leaflet 165. Washington, DC: United States Department of Agriculture, Forest Service. 8p.

Williams, R.E.; Shaw, C.G. III.; Wargo, P.M.; Sites, W.H. 1986. Armillaria root disease. Forest Insect & Disease Leaflet 78. Washington, DC: United States Department of Agriculture, Forest Service. 8p.

APPENDIX H:

USDA Forest Service National Forest System Data Recording Protocols and Requirements for Invasive Species Survey, Inventory, and Treatment

USDA Forest Service National Forest System
Data Recording Protocols and Requirements for Invasive Species *Survey, Inventory, and Treatment*

Activity Integration Version:04/01/2012

USDA Forest Service National Forest System
Data Recording Protocols and Requirements for Invasive Species *Survey, Inventory, and Treatment*

Data Recording Protocols and Requirements for Invasive Species Survey, Inventory and Treatment Activities

Table of Contents

Page

Introduction ……..... 3
National Standards and Requirements...……6
Invasive Species Survey…….6
Invasive Species Inventory……7
Invasive Species Treatment……7
National Spatial Requirements for Invasive Species Data…….8
Required Invasive Species Survey Attributes…..…….……11
Optional Invasive Species Survey Attributes……...……12
Required Invasive Species Infestation Attributes…….14
Optional Invasive Species Infestation Attributes..……17
Optional Site Attributes…….19
Invasive Species Monitoring (Re-measurements)……..21
Invasive Plants without a Crosswalk in PLANTS Database…….22
Optional Location Detail for Survey and Inventory……..23
Required Treatment Area Attributes…….25
Basic Invasive Species Treatment Activity –Required Attributes……26
Inventory/Target Species Attributes……..28
Pesticide Application Records..…….28
Biological Treatment Records……..……..32
Treatment Effectiveness Monitoring……..35
Location Detail for Treatment Area……....38
Appendix A: General Terminology……39
Appendix B: Infested Area Treated and Application Area……43
Appendix C: List of Values (LOV)……45

I. Introduction

The management of aquatic and terrestrial invasive species (including plants, pathogens, algae, vertebrates, and invertebrates) are critical components of the resource stewardship responsibilities of the USDA Forest Service. As articulated in FSM 2900 (Invasive Species Management), the term "invasive species" refers to any harmful exotic species of plant, algae, vertebrate, invertebrate or pathogen meeting the Executive Order 13112 definition of "invasive species". Management policy under FSM 2900 also applies to harmful plants regulated as "noxious weeds" under State or Federal Statute. Invasive species impact all aquatic and terrestrial ecosystems. As we implement actions against these exotic invaders, we utilize many kinds of information on the location, extent, impacts, treatment efficacy, and rate of spread of infestations. Practitioners use a variety of widely-accepted survey, inventory, and mapping techniques to systematically collect infestation and occurrence data, including accurate spatial and tabular information. These techniques can be site-specific or species-specific. In addition, treatment activities may also be species-specific or site-specific, and are based upon widely-accepted integrated management techniques; some of which have standardized procedures.

However, the protocols and requirements in this document are strictly related to the recording of information related to invasive species survey, inventory and treatment activities at the specific site level that has been conducted on any aquatic or terrestrial area of the National Forest System. These data recording protocols and requirements provide a standardized approach for the recording of invasive species survey/detection activities, infestation/ occurrence data and treatment data collected in the field. **These protocols do not provide guidance or designs for the development of integrated management plans for controlling or eradicating invasive species, or guidance on detection, survey, or inventory operations in the field.** That is, the user will not find information in this document to help him/her select the most effective integrated treatments available to achieve control of a particular invasive species or group of invasive species, or specifically how to detect a particular invasive species invasion. A compiled set of guidance on detecting, controlling, and other management activities against invasive species will be available in Forest Service Handbook 2909.11 when finalized.

The data recorded using these protocols will be a key source of information for reporting invasive species population or infestation levels, invasive species management planning, impact analyses and risk assessments as well as the basis for reporting information related to treatment and treatment monitoring of invasive species.

A Landscape Approach for Data Sharing

Invasive species infestations cross-jurisdictional boundaries and are seldom managed in isolation. A cornerstone of invasive species management is cooperation and coordination with adjacent land ownerships and jurisdictions. This cooperation requires that information on the management of invasive species be shared. These data recording protocols and requirements are based on internationally recognized standards and meet National Forest System invasive species program

reporting requirements. By using universally accepted data management standards and protocols, information can be easily shared between a variety of public and private organizations conducting invasive species management activities. Some of the data elements identified in these protocols may be optional for Forest Service use; but if used, can greatly facilitate data sharing with other cooperators across the broader landscape.

Area of Use and Database System Requirements

These record keeping protocols and requirements are applicable to all aquatic and terrestrial invasive species infestations, all invasive species research and management activities, and apply in any ecosystem type or area across the National Forest System. These protocols apply only to data associated with invasive species. The collecting and recording of native pest management information (i.e. native forest pest insects, resident pest mammals, etc.) does not apply.

NRM-FACTS (Forest ACtivity Tracking System) and NRM-TESP/IS (Invasive Species Survey and Inventory Application) are, respectively, the Databases of Record for all treatment/treatment monitoring data and all survey/inventory data, related to invasive species management activities occurring on National Forests and Grasslands regardless of funding source or project objective. Future modifications to the national Databases of Record must meet the Agency's application architectural standards, security requirements, and invasive species management program standards and requirements as well as be sanctioned and approved by NRM and the NFS director responsible for the Invasive Species Program activities on the National Forest System.

Relationships between Treatment Data and Survey/Inventory Data

The user should be aware of the relationship between treatment data stored in NRM-FACTS and invasive species inventory data stored in NRM-TESP/IS. In most cases, invasive species infestations/occurrences will be surveyed and if found recorded in TESP/IS prior to treatment. There are situations where invasive species treatment activities will occur concurrently with the discovery of a new infestation/occurrence.

In many cases successful invasive species control or eradication programs require multiple treatments on the same site, during the same season/year, or over multiple years. The resulting data collected on these activities can be confusing without adequate descriptors in place to sort the treatments apart. By objectively delineating and recording these reoccurring activities, program managers can more accurately portray the effectiveness of invasive species treatment performance. This protocol outlines the standards for recording field data related to invasive species treatment activities conducted on an infested site, such as pesticide applications, mowing, burning, trapping, and biological control tactics, etc. and will serve to document effectiveness monitoring of the treatment and overall restoration outcomes.

Data can be recorded in the field using the standard field form for Surveys and Infestations then entered into the appropriate application through a set of data entry/editing screens. By using standardized protocols for recording of critical information related to treating invasive species, the quality and value of the data collected will improve. Generally speaking, increasing the amount of data collected does not necessarily equate to better information unless it is properly utilized. Therefore, these protocols and standards represent a selection of required and optional data elements which support the invasive species management activities of the National Forest System and any additional data collected will be determined by the needs of individual Forests and Regions.

INVASIVE SPECIES MANAGEMENT PERFORMANCE

Invasive species survey and inventory activities are typically a key component of a successful invasive species management program. In some cases, a substantial amount of agency resources are expended on surveying for and recording data for invasive species infestations in order to identify the level of threat, set management priorities, communicate with the public, and develop sound integrated strategic plans.

At the national level, invasive species management success is not measured by the amount of pre-treatment survey and inventory work being completed, and thus there are no associated national performance measures. However as previously mentioned the inventory is a critical element in quantifying threat levels and establishing the foundation for an integrated treatment program.

Local-level invasive species treatment activities and efficacy records will be used to generate output and outcome performance reports at the national level. These national invasive species program performance measures are as follows:

Output ***Number of priority acres treated against invasive species***
The total number of priority acres treated is based on the annual program capabilities. Risk assessments and other scientific methods and systems are used to identify priority acres for treatment in a project plan. Priority acres treated are a subset of the Demand. Program outputs (acres treated) are reported annually.

Output ***Number of priority acres monitored for treatment efficacy***
The acres monitored are based on the level of post treatment efficacy evaluation in relation to the total number of priority acres treated.
Outcome ***Percentage (%) of priority acres successfully restored against targeted invasive species.***
The percentage of priority acres successfully restored is based on the objectives within a project plan – where the targeted species defined in the project plan were prevented, controlled, or eradicated on the priority acres identified in the plan. The program outcome is a long-term (5 -10 yrs) measure of program performance. This long term program performance will be calculated from data collected annually that describes annual treatment efficacy. The number of priority acres

restored against invasive species are reported in the Performance Accountability System by summarizing data from NRM-FACTS. *6*

TRAINING IN THE USE OF THE NATIONAL APPLICATION AND PROTOCOLS

Users must have basic knowledgeable in invasive species identification, basic mapping skills and the ability to estimate canopy cover of weed infestations.

II. National Standards and Requirements

The National Protocol is based on searching, detecting and recording single species infestation or occurrence where the target species has been identified as an invasive organism on the project site.

Invasive Species Survey:

Invasive species survey is the process of systematically searching a geographic area for a particular (target) invasive species or a group of species. Surveys may be conducted as part of Early Detection – Rapid Response (EDRR) process as well as during project planning such as road construction, timber sales or prescribed burning where the purpose of the survey is to locate any invasive species within the project area prior to site disturbance.

It is important to know where and when surveys have occurred, even if the object of the survey (target species) was not located. Information on the absence of invasive species in specific areas can be as valuable as information on the presence of the species.

The minimum national requirements for invasive species survey include documenting a set of core attributes:

1. What was the target(s) of the search - requires a standard national **Species Code** that includes scientific name and common name, and **Target Focus**.;
2. What type of survey was conducted – requires **Survey Type** and **Survey Focus**;
3. Where was the survey conducted - requires a unique identifier (**Survey_ID**) and **spatial polygon**;
4. How large was the search area – requires a polygon, with area calculated in acres from the spatial feature;
5. Who conducted the search – requires **Examiner**;
6. When was the area searched – requires **Survey Date**(s)
7. How was the survey financed – requires the Budget Line Item **Fund Code** that provided financing with the **fiscal year** the funds were obligated.

Invasive Surveys can be approached in two ways. One approach is to document the survey as it is completed in the field. All the required core attributes would be recorded during field work and electronically entered in the TESP-IS Application to meet the minimum national business requirements.

The second approach creates Pre-survey records and a set of minimum attributes to describe a proposed or planned survey. Not all of the required core attributes would need to be recorded at this time. Since some surveys may extend over many weeks and over large geographic area, data would then be added to the pre-survey records as the survey is implemented. The updated records

would be flagged as “Active”. Once the work is completed the entire set of core attributes would be required and the survey record coded as “Completed”.

Invasive Species Inventory:

Invasive Species Inventory is a collection of data related to the occurrence, population or infestation of a detected invasive species across a landscape or with respect to a more narrowly-defined area or site.

When a target species is detected, a set of spatial and tabular core attributes are recorded to meet the minimum national requirements**:**

1. What was found - requires a standard national **Species Code** that includes scientific name and common name, and **Species Category**;
2. Where was it found - requires a unique identifier (**Infestation_ID**), **spatial polygon**, **Ownership** and if necessary **Proclaimed Forest**;
3. How much was found - requires a **spatial polygon, Percent Infested** and **Infested Area**;
4. Who found it - requires **Examiner;**
5. When was it found - requires **Date.**

The national protocol also includes a standard set of attributes that allow users to collect optional descriptive data related to the target species or site at the time of observation. The optional fields can be used to create qualitative and quantitative baseline assessment of the infestation or population for later evaluations.

Invasive Species Treatment:

With respect to invasive species management, the term “treatment” refers to any activity or action taken to directly eradicate, control or prevent or otherwise manage the spread of an invasive species infestation. Treatment of an infestation does not necessarily result in the immediate elimination of the infestation, particularly when multiple treatments are required to affect a change in the survival of the target species infestation. Treatments can include actions within any of the 4 general categories of integrated pest management techniques: Biological treatments, Cultural treatments, Physical/Mechanical treatments, or Chemical treatments. Since the national application where invasive species management data will be stored, is structured to include a broad range of management activities on the National Forests, treatment data includes a set of common fields that all management activities will collect. There are essentially four required categories of data collected on invasive species treatments:

1. Basic elements of documenting Treatment Areas.
2. Spatial features depicting the Treatment Area.
3. Specific treatment activity core attributes including effectiveness monitoring.
4. Identifying the target of the treatment activity through association with invasive species inventory record.

Treatment Area (Activity Subunits)
The basis for managing information on invasive species treatment is the creation of a **Treatment Area.** The Treatment Area (synonymous with Activity Subunit**)** is a specific piece of land or water on which a management activity or series of management activities occur across the entire area. Treatment Areas may overlap, but cannot be divided. A **Treatment Area** may include an entire invasive species infestation, a portion of an infestation, or include multiple infestations that are adjacent or overlapping. In order to maintain the integrity of program accountability and maintain accurate records of where our invasive species management activities occur on the landscape, each **Treatment Area** should have a spatial representation. **Treatment Areas** will be linked to a single spatial feature which will be a polygon.

Treatment Activity
Treatment Activity is a management entry across a treatment area to meet specific resource objectives. Pesticide application or mowing is considered to be an activity. With respect to invasive species management, the term "treatment" refers to any activity or action taken to directly eradicate, control or otherwise manage the spread of an invasive species infestation.
The actual spatial extent of the treatment activity will determine if additional Treatment Areas are necessary. For some smaller treatments (typically no more than a few acres in size) which are very closely associated (adjacent or overlapping) on the landscape, it may be appropriate to group those treatments under one multi-part polygon. However, it would not be appropriate to group treatments which are significantly distant from each other, because the larger spatial representation would inaccurately depict the actual location where the management activity occurred. This inaccuracy would make it difficult to defend management actions during lawsuits and would provide little value to future managers as a historical account of the management activity applied to the landscape.

National Spatial Requirements for Invasive Species Data

The National Standard requires spatially locating and delineating each survey area, invasive species infestation/occurrence, and each treatment area as polygons. Each polygon represents a single survey area, a single invasive species infestation/occurrence which may overlap. Each treatment polygon (including multiple parts) represents a single site-specific area within which a number of treatment activities may be recorded. Multiple **Treatment Activity** records may be associated with a single **Treatment Area** if the activity covers the entire spatial extent of the treatment area. Otherwise, a new treatment area (subunit) must be created. Copying an existing polygon created for another purpose – i.e. a timber harvest unit or fuels treatment– for the **Treatment Area** is acceptable only if the **Treatment Activity** covers the entire spatial extent. Spatial representations can be created by a number of methods:

Hand-drawing the perimeter of the survey or infestation on maps or aerial photos, then redrawing the feature within the National Application;

Using a GPS (Global Positioning System) device to define the perimeter, converting them to a shapefile, and importing the file;

Digitizing with a computerized mapping system (Geographic Information System [GIS]) and importing it.

Using a combination of Mobile software to create a polygon which is loaded directly into the parent application.

Regardless of the method used to delineate an Infestation in the field, the protocol requires that the polygon be digitized and stored in ArcGIS format in the system of record. To ensure consistency, the scale for hand-drawn occurrences on maps should be 1:24,000. This is the scale of United States Geological Survey (USGS) 7.5-minute quadrangle (quad) maps. (**Note:** the 1:24,000 scale is also the standard for invasive plant mapping as recommended by the International Mapping Standards for Invasive Plants). Aerial photos, orthophoto quads and remote sensing approaches can also be useful formats for delineation.

The minimum size for a delineated polygon can be as small as 0.0001 acre (4.4 sq. ft.). The NRM application will allow very small polygons to accurately depict and locate small infestations.
A single survey area infestation or treatment area may be comprised of more than one polygon (multi-part polygon). For example, a single infestation may be defined by clumps or patches of the same population in close proximity. Species and site tabular data such as % Infested, Cover, Density, and Count would apply to the ***entire*** infestation. Although each clump or patch can be individually drawn, acres for all the polygons are combined to calculate the Total Area in the NRM application.

Line and point data (layers) are not supported. Surveys, Infestations or treatments that could be mapped as "lines," such as those occurring along ridges, streams, trails, or roadsides, will be stored as long, narrow polygons. Tools within the application will be available to buffer lines and covert the selected line feature to a polygon.

Using the diagram below as an example, a spatial feature would be created for the insect release of Subunit 004, a single polygon would be created for the two days of herbicide application of Subunit 003, and a spatial feature would be created for the invasive vertebrate trapping project of Subunit 001. If a subsequent treatment occurred on the subunit and the treated area did not change, additional Activity records could be added to the *Activity Subunit* represented by the same spatial feature. As an example, a crew returned to Subunit 002 the following year and treated the entire area, a new activity would be added to the existing subunit. If however, the area of the subsequent treatment is significantly different (20% difference) from the previous activity or a different treatment is used, a new subunit and feature would be created. As an example a crew returns to Subunit 002 the following year and treats the upper 50% of the original unit, a new Activity Subunit (005) would be created.

Diagram 1 – Invasive Species Treatment
Activity Unit-Subunit 000 – spatial feature not required without activity record.
Subunit 001, **Activity 2530**, Trapping invasive vertebrate
Spotted Knapweed Infestation, NRIS-TERRA, **SITE_ID**: 011701-CEBI2-01
Subunit 002, **Activity 2510 - Pesticide Application**, Aquatic vertebrate Control
Subunit 003, **Activity 2510 - Pesticide Application**, Tordon 22K/2,4-D **(Day 1)**
Subunit 003, **Activity 2510 - Pesticide Application**, Tordon 22K/2,4-D **(Day 2)**
Subunit 004, **Activity 2550 - Biocontrol Insect Release** Location
Forest Road 1422

Equipment

The spatial requirement is the basis for the Forest Service corporate data management applications, specifically the TESP-IS Application. The TES-IS application uses an ArcGIS Task Assistant (TA) and Feature Inspector (FI) data entry process to guide the user through a common workflow to enter and edit survey, inventory or treatment area polygons and the associated attributes.

Data collection hardware, such as Global Position System (GPS) devices, desktop computers, portable data recorders (PDR) and/or field tablets, etc can be helpful for efficiently collecting and entering data into the corporate applications, locating and relocating infestation sites, and automating electronic data transfer. *11*

III. Invasive Species Survey Attributes (Required)

	Description
Survey ID (***Required***): A unique identifier of the survey. The Survey ID can be any combination of numbers and letters, up to 30 characters in length. It is recommended that the combination of Region, Forest, and District numbers form the first six digits of the Survey ID. An example: **Survey ID** 011701IPS05LL01	Region(2), Forest(2), District(2), Protocol(3), FY(2) initials(2), number(2)

APPENDIX I:

Ozark-St. Francis National Forests' Threat Decision Matrix for Non-native invasive plant infestations

Threat Decision Matrix for Non-native Invasive Plant Infestations

Districts should complete the Threat Decision Matrix worksheet in this document following guidance provided below. A Threat Decision Matrix example is also included.

I. Current extent of the species:

1. Low Priority- Species present in large infestations that are not expanding.
2. Moderate Priority- Species present in large infestations that continue to expand.
3. High Priority- Species present as new populations or outliers of larger infestations, especially if they are expanding rapidly.
4. Highest Priority- Species not yet on the site but are present nearby.

II. Current and potential impacts of the species:

1. Low Impact- Species that overtake and exclude natives following natural disturbances that hinder restoration of natural communities.
2. Moderate Impact- Species that do not out compete dominant natives but:
   a. prevent or depress recruitment or regeneration of native species.
   OR
   b. reduce or eliminate resources (e.g., food, cover, nesting sites) used by native animals
   OR
   c. promote populations of invasive non-native animals by providing them with resources they wouldn't have otherwise.
3. High Impact- Species that out compete natives and dominate otherwise undisturbed native communities.
4. Highest Impact- Species that alter ecosystem processes such as fire frequency, sedimentation, nutrient cycling, or other ecosystem processes.

III Quality of the site that species infest or could infest:

1. Low Quality- Poor quality resources.
2. Moderate Quality- Resources present or nearby, but sensitive and valuable resources absent.
3. High Quality- Sensitive or valuable resources on site or nearby.
4. Highest Quality- Multiple sensitive resources on site or nearby.

IV Difficulty of control and establishing replacement species:

1. Low Difficulty- Species unlikely to be controlled with available technology and resources.
2. Moderate Difficulty- Species difficult to control with available technology and resources and/or whose control will likely result in substantial damage to other, desirable species.
3. High Difficulty- Species likely be controlled but will not be replaced by desirable natives without an active restoration program requiring substantial resources.
4. Highest Difficulty- Species likely to be controlled or eliminated with available technology and resources, and for which desirable native species will replace the invasive with minimal agency resource input.

Example Threat Analysis Summary:

The kudzu population is a relatively new infestation, with high potential impacts (highly invasive), in highly valued site, and is easy to control due to its small infestation size. The Multiflora Rose infestation is large, not excluding other plants, in low value site, and difficult to control due to its size. If a manager had to pick between these two infestations, the Threat Analysis dictates that the higher score kudzu site garners a higher priority.

District Name – Sample Ranger District						
Project Name	Species	**I.** Current Extent	**II.** Current/Pot. Impacts	**III.** Site Value	**IV.** Ease of Control	Priority Score
Mulberry Kudzu	Kudzu	3	4	4	4	15
Multiflora Eradication	Multiflora Rose	1	2	3	2	8

NNIS Threat Decision Matrix Worksheet

Table 1: Threat Analysis Matrix District -						
Project Name	Species	**I.** Current Extent	**II.** Current/Pot. Impacts	**III.** Site Value	**IV.** Ease of Control	Priority Score

APPENDIX J:

Procedures for Inadvertent Discovery of Human Remains and Burials

PROCEDURES FOR INADVERTENT DISCOVERY OF HUMAN REMAINS AND BURIALS

The procedures for an Inadvertent Discovery of Human Remains are specified; and burial items or sacred objects are defined in the Native American Graves Protection and Repatriation Act (NAGPRA). In the case of an inadvertent discovery of human remains or burials on National Forest Service land, the Forests will follow the procedures outlined by NAGPRA as amended (43 CFR 10, Subpart B which supercedes Arkansas and Oklahoma state laws), the Archaeological Resources Protection Act of 1979 (43 CFR 7), and follow these procedures:

Upon encountering human remains or an unmarked human burial during ground disturbing construction activities, the Forests will ensure that the construction activity immediately stops work within a one-hundred-fifty (150) foot radius from the point of discovery and where further subsurface remains can reasonably be expected to occur. The person in charge of the ground disturbing activity will immediately notify the Heritage Program Manager by telephone or radio along with written confirmation of the discovery, and will implement interim measures to protect the discovery from vandalism and looting, but must not remove or otherwise disturb any human remains or other cultural items in the immediate vicinity of the discovery.

Following notification of the discovery, the Heritage Program Manager will immediately inspect the work or activity site and cover the burial with impermeable plastic sheeting and mark the area with lathing stakes or fencing. The Forest shall take all reasonable means to protect and safeguard the human remains and associated cultural items until final disposition is determined.

3. The Heritage Program Manager will notify the Forest Supervisor, Forest Law Enforcement, the appropriate SHPO, and the Tribes within forty-eight (48) hours of the discovery of unmarked human remains, associated or unassociated funerary objects, artifacts, or cultural features. The Heritage Program Manager will contact the Tribal Point of Contact by telephone and email to include date, location, project identification, description of the find, reference to original survey, and status of protective measures of the discovery. Tribal points of contact are included in Appendix 2. Follow up contacts may be necessary to confirm receipt.

The Forest Service law enforcement official will immediately notify the appropriate sheriff's office and county coroner of the discovery of human remains upon receipt of notification by the Heritage Program Manager.

As soon as possible, but no later than seventy-two (72) hours after notification, law enforcement will determine jurisdiction. If upon investigation, the law enforcement officer determines that the remains are not involved in a legal investigation, the Forest shall resume responsibility for such remains. Criminal investigations respect the honor and integrity of recent human remains as well as prehistoric human remains. Any crime scene investigation photographs are curated in evidence

lockers until adjudication, and are then returned to the culturally affiliated or claiming Tribes for respectful disposal. Drawings, evidence, and other information are retained in ARPA Project Files.

Unless the remains were inadvertently removed, the evaluation will be conducted at the site of discovery if possible. The Heritage Program Manager, in consultation with the culturally affiliated or claiming Tribes, appropriate SHPO, and other interested parties such as living descendants, may consult with a qualified physical anthropologist, forensic scientist, or other experts as may be needed to examine and assess the inadvertant discovery. The consulting expert will be allowed to draw and measure the exposed remains *in situ*, draw and analyze associated funerary objects *in situ*, Point plotted drawings, and other records will be curated at a state approved curation facility in the state of discovery (Arkansas or Oklahoma) that meets the federal curation standards set forth at 36 CFR Part 79. Point plotted drawings cannot be published in any form or shown as part of scholarly presentations without the written permission of the culturally affiliated or claiming tribe, or nearest living descendant.

If the Heritage Program Manager determines that the human remains are Native American, the Heritage Program Manager will notify the Tribes and appropriate SHPO by telephone and email within twenty-four (24) hours, with formal U.S. Mail correspondence to follow. The notification shall include the results of the coroner and law enforcement findings (ARPA File) and any crime scene photographs (pending adjudication) of human remains, along with general location information, the likely priority of custody, and other details or written descriptions of the remains including their potential age and cultural affiliation.

Tribes receiving notification will respond verbally within seventy-two (72) hours followed by response via U.S. mail or electronic mail. The response should specify the party's intention to conduct further consultation or decline consultation.

NAGPRA Plan of Action. The Forest will consult with the Tribes and the appropriate SHPO to create a NAGPRA plan of action that may include:

- Formal archaeological evaluation of the site;
- Visits to the site by the Tribes and SHPO;
- Exploration of potential alternatives to avoid the human remains or burial;
- Implementation of a mitigation plan by the Forests in consultation with the Tribes and appropriate SHPO, including procedures for disinterment and reinterment; and
- The Forests, in consultation with the Tribes and appropriate SHPO, will provide the approval to resume ground disturbing activity following completion of the fieldwork component of the mitigation plan.

Records. Associated drawings and other records will be held at a state approved curation facility that meets the federal curation standards set forth at 36 CFR Part 79, as well as a copy kept in a secure location by the Forest Archaeologist at the Supervisor's Office. Associated drawings and other records cannot be published in any form or shown as part of scholarly presentations without the written permission of the culturally-affiliated Tribe, or nearest living descendant, or in the absence of these, concurrence from consulting Tribes. Photographs are to be used only for crime

scene investigation and adjudication and are then returned to the culturally affiliated or claiming Tribes for respectful disposal.

Reburial. If reburial on Forest Service property is requested by the consulting Tribes, the Forest will consult with all interested Tribes to establish a mutually agreed upon agenda. Through consultation among the Forest and the Tribes, a determination of cultural affiliation of the human remains shall be attempted to mutual tribal satisfaction and a draft treatment plan developed. Where appropriate, the claiming or affiliated Tribes shall be able to visit the site with the Heritage Program Manager.

Reburial Plan. At the completion of consultation, a draft treatment plan shall be written to clearly designate the decisions that have been agreed upon by each party regarding reburial sites. The reburial plan will outline procedures, restrictions, and timelines to be followed in the reburial process.The reburial plan will be drafted by the affiliated or claiming tribes and the appropriate Heritage Program Manager. The final reburial plan will be signed by the Forest and the claiming or affiliated Tribes. The preferred reburial plan is *in situ* (in place) reburial.

Elements.

- General procedures which may include access to the reburial area by claiming or affiliated Tribes and other procedures specific to the locality
- Restrictions, if any, relating to the reburial area, including but not limited to restrictions relating to proposed changes from current land use in the reburial area, maintenance restrictions, and restrictions regarding the marking of grave sites
- Security of the reburial area
- Long-term coordination with the claiming or affiliated Tribes

Confidentiality agreement. A confidentiality clause will be included in the Reburial Plan for each reburial site. The clause shall stipulate the location of the reburial not be disclosed to the public, and shall only be disclosed to those Forest employees who have a need to know. Access to such proprietary information will be limited to appropriate Forest personnel.

The claiming or affiliated Tribes shall be afforded the opportunity to conduct religious ceremonies with regard to Native American human remains and funerary objects on the site itself.

APPENDIX K:

Scenic Integrity Level Descriptions and Scenic Stability Definitions

Scenic Integrity Level Descriptions

(From) *Landscape Aesthetics: A Handbook for Scenery Management* (U.S. Forest Service, 1995)

VERY HIGH scenic integrity refers to landscapes where the valued landscape character is intact with only minute if any deviations. The existing landscape character and sense of place is expressed at the highest possible level.

HIGH scenic integrity refers to landscapes where the valued landscape character appears intact. Deviations may be present but must repeat the form, line, color, texture, and pattern common to the landscape character so completely and at such scale that they are not evident.

MODERATE scenic integrity refers to landscapes where the valued landscape character appears slightly altered. Noticeable deviations must remain visually subordinate to the landscape character being viewed.

LOW scenic integrity refers to landscapes where the valued landscape character "appears moderately altered. Deviations begin to dominate the valued landscape character being viewed but they borrow valued attributes such as size, shape, edge effect and pattern of rural openings, vegetative type changes or architectural styles outside the landscape being wed. They should not only appear as valued character outside the landscape being wed but compatible or complimentary to the character within.

VERY LOW scenic integrity refers to landscapes where the valued landscape character appears heavily altered. Deviations may strongly dominate the valued landscape character. They may not borrow from valued attributes such as size, shape, edge effect and pattern of natural openings, vegetative type changes or architectural styles within or outside landscape being viewed. However deviations must be shaped and blended with the natural terrain (landforms) so that elements such as natural edges, roads, landings and structures do not dominate the composition.

UNACCEPTABLY LOW scenic integrity refers to landscapes where the valued landscape character being viewed appears extremely altered. Deviations are extremely dominant and borrow little if any form, line, color, texture, pattern or scale from the landscape character. Landscapes at this level of integrity need rehabilitation. This level should only be used to inventory existing integrity. It must not be used as a management objective.

Scenic Stability Definitions

(From) *Landscape Aesthetics: A Handbook for Scenery Management* (U.S. Forest Service, 1995)

Very High Stability- all dominant and minor scenery attributes of the valued scenic character are present and likely to be sustained.

High Stability- all dominant scenery attributes of the valued scenic character are present and likely to be sustained. However, there may be scenery attribute conditions and ecosystem stressors that present a low risk to the sustainability of the dominant scenery attributes.
Moderate Stability- most dominant scenery attributes of the valued scenic character are present and are likely to be sustained. A few may have been lost or are in serious decline.
Low Stability- some dominant scenery attributes of the valued scenic character are present and are likely to be sustained. Known scenery attribute conditions and ecosystem stressors may seriously threaten or have already eliminated the others.

Very Low Stability- most dominant scenery attributes of the valued scenic character are seriously threatened or absent due to their conditions and ecosystem stressors and are not likely to be sustained. The few that remain may be moderately threatened but are likely to be sustained.

No Stability- all dominant scenery attributes of the valued scenic character are absent or seriously threatened by their conditions and ecosystem stressors. None are likely to be sustained, except relatively permanent attributes such as landforms.

APPENDIX L:

Fire Regime Condition Class

Fire Regime Condition Class

A natural fire regime is a general classification of the role fire would play across a landscape in the absence of modern human mechanical intervention, but including the influence of aboriginal burning (Agee 1993, Brown 1995). Coarse-scale definitions for natural (historical) fire regimes have been developed by Hardy et al. (2001) and Schmidt et al. (2002) and interpreted for fire and fuels management by Hann and Bunnell (2001). The five natural (historical) fire regimes are classified based on average number of years between fires (fire frequency) combined with the severity (amount of replacement) of the fire on the dominant overstory vegetation. These five regimes include:

I – 0-35 year frequency and low (surface fires most common) to mixed severity (less than 75% of the dominant overstory vegetation replaced);

II – 0-35 year frequency and high (stand replacement) severity (greater than 75% of the dominant overstory vegetation replaced);

III – 35-100+ year frequency and mixed severity (less than 75% of the dominant overstory vegetation replaced);

IV – 35-100+ year frequency and high (stand replacement) severity (greater than 75% of the dominant overstory vegetation replaced);

V – 200+ year frequency and high (stand replacement) severity.

As scale of application becomes finer these five classes may be defined with more detail, or any one class may be split into finer classes, but the hierarchy to the coarse scale definitions should be retained.

A fire regime condition class (FRCC) is a classification of the amount of departure from the natural regime (Hann and Bunnell 2001). Coarse-scale FRCC classes have been defined and mapped by Hardy et al. (2001) and Schmidt et al. (2002) (FRCC). They include three condition classes for each fire regime. The classification is based on a relative measure describing the degree of departure from the historical natural fire regime. This departure results in changes to one (or more) of the following ecological components: vegetation characteristics (species composition, structural stages, stand age, canopy closure, and mosaic pattern); fuel composition; fire frequency, severity, and pattern; and other associated disturbances (e.g. insect and diseased mortality, grazing, and drought). There are no wildland vegetation and fuel conditions or wildland fire situations that do not fit within one of the three classes.

The three classes are based on low (FRCC 1), moderate (FRCC 2), and high (FRCC 3) departure from the central tendency of the natural (historical) regime (Hann and Bunnell 2001, Hardy et al. 2001, Schmidt et al.). The central tendency is a composite estimate of vegetation characteristics (species composition, structural stages, stand age, canopy closure, and mosaic pattern); fuel composition; fire frequency, severity, and pattern; and other associated natural disturbances. Low departure is considered to be within the natural (historical) range of variability, while moderate and high departures are outside.

Characteristic vegetation and fuel conditions are considered to be those that occurred within the natural (historical) fire regime. Uncharacteristic conditions are considered to be those that did not occur within the natural (historical) fire regime, such as invasive species (e.g. weeds, insects, and diseases), "high graded" forest composition and structure (e.g. large trees removed in a frequent surface fire regime), or repeated annual grazing that maintains grassy fuels across relatively large areas at levels that will not carry a surface fire. Determination of amount of departure is based on comparison of a composite measure of fire regime attributes (vegetation characteristics; fuel composition; fire frequency, severity and pattern) to the central tendency of the natural (historical) fire regime. The amount of departure is then classified to determine the fire regime condition class. A simplified description of the fire regime condition classes and associated potential risks follow.

Fire Regime Condition Class	**Description**	**Potential Risks**
Condition Class 1	Within the natural (historical) range of variability of vegetation characteristics; fuel composition; fire frequency, severity and pattern; and other associated disturbances	Fire behavior, effects, and other associated disturbances are similar to those that occurred prior to fire exclusion (suppression) and other types of management that do not mimic the natural fire regime and associated vegetation and fuel characteristics. Composition and structure of vegetation and fuels are similar to the natural (historical) regime. Risk of loss of key ecosystem components (e.g. native species, large trees, and soil) are low

Fire Regime Condition Class	Description	Potential Risks
Condition Class 2	Moderate departure from the natural (historical) regime of vegetation characteristics; fuel composition; fire frequency, severity and pattern; and other associated disturbances	Fire behavior, effects, and other associated disturbances are moderately departed (more or less severe). Composition and structure of vegetation and fuel are moderately altered. Uncharacteristic conditions range from low to moderate. Risk of loss of key ecosystem components are moderate
Condition Class 3	High departure from the natural (historical) regime of vegetation characteristics; fuel composition; fire frequency, severity and pattern; and other associated disturbances	Fire behavior, effects, and other associated disturbances are highly departed (more or less severe). Composition and structure of vegetation and fuel are highly altered. Uncharacteristic conditions range from moderate to high. Risk of loss of key ecosystem components are high

More detailed descriptions of the fire regime condition classes and associated attributes are provided in the following table.

Condition Class	Fire Regime	Example Management Options	Examples of Key Ecosystem Component Susceptibility to Changing Fire Regime Condition Classes			
			Species composition and structure	**Invasion by non-native species**	**Smoke production hydrology, and Soils**	**Insects and disease**
Condition Class 1	Fire regimes are within the natural (historical) range, and the risk of losing key ecosystem components is low. Vegetation attributes (species composition, structure, and pattern) are intact and functioning within the natural (historical) range.	Where appropriate, these areas can be maintained within the natural (historical) fire regime by treatments such as fire use.	Species composition and structure are functioning within their natural (historical) range at both patch and landscape scales.	Non-native species are currently not present or present in limited extent. Through time or following disturbance sites are potential vulnerable to invasion by non-native species	Functioning within their natural (historical) range.	Insect and disease populations functioning within their natural (historical) range.
Condition Class 2	Fire regimes have been moderately altered from their natural (historical) range.	Where appropriate, these areas	Species composition and structure have been moderately altered from their historical range at patch and	Populations of non-native invasive species	Have been moderatel	Insect and disease population

Condition Class	Fire Regime	Example Management Options	Examples of Key Ecosystem Component Susceptibility to Changing Fire Regime Condition Classes			
			Species composition and structure	**Invasion by non-native species**	**Smoke productio n hydrology , and Soils**	**Insects and disease**
	Risk of losing key ecosystem components is moderate. Fire frequencies have departed from natural frequencies by one or more return intervals (either increased or decreased). This result in moderate changes to one or more of the following: fire size, intensity and severity, and landscape patterns. Vegetation and fuel attributes have been moderately altered from their natural (historical) range.	may need moderate levels of restoration treatments, such as fire use and hand or mechanical treatments, to be restored to the natural fire regime.	landscape scales. For example: <u>Grasslands</u> – Moderate encroachment of shrubs and trees and/or invasive exotic species. <u>Shrublands</u> – Moderate encroachment of trees,increased shrubs, or invasive exotic species. <u>Forestland/Woodland</u> – Moderate increases in density, encroachment of shade tolerant tree species, or moderate loss of shade intolerant tree species caused by fire exclusion, logging, or exotic insects or disease. Replacement of surface shrub/grass with woody fuels and litter.	may have increased, thereby increasing the potential risk for these populations to expand following disturbances, such as wildfires.	y altered from their natural (historical) range. Water flow typically less. Smoke and soil erosion following fire typically greater.	have been moderatel y altered from their natural (historical) range.
Condition	Fire regimes have been	Where	Species composition and structure	Invasive species	Have	Insect and

Condition Class	Fire Regime	Example Management Options	Examples of Key Ecosystem Component Susceptibility to Changing Fire Regime Condition Classes			
			Species composition and structure	**Invasion by non-native species**	**Smoke productio n hydrology , and Soils**	**Insects and disease**
Class 3	substantially altered from their natural (historical) range. The risk of losing key ecosystem components is high. Fire frequencies have departed from natural frequencies by multiple return intervals. Dramatic changes occur to one or more of the following: fire size, intensity, severity, and landscape patterns. Vegetation attributes have been substantially altered from their natural (historical) range.	appropriate, these areas may need high levels of restoration treatments, such as hand or mechanical treatments, before fire can be used to restore the natural fire regime.	have been substantially altered from their historical range at patch and landscape scales. For example: <u>Grasslands</u> – High encroachment and establishment of shrubs, trees, or invasiveexotic species. <u>Shrublands</u> – High encroachment andestablishment of trees, increased shrubs, or invasive exotic species. <u>Forestland/Woodland</u> – High increases in density, encroachment of shade tolerant tree species, or	may be common and in some cases the dominant species on the landscape. Any disturbance will likely increase both the dominance and geographic extent of these invasive species.	been substantia lly altered from their historical range.	disease population have been substantial ly altered from their natural (historical) range. Typically higher mortality or defoliation .

Condition Class	Fire Regime	Example Management Options	Examples of Key Ecosystem Component Susceptibility to Changing Fire Regime Condition Classes			
			Species composition and structure	Invasion by non-native species	Smoke production hydrology, and Soils	Insects and disease
			high loss of shade intolerant tree species caused by fire exclusion, logging, or exotic insects or disease.			

Prior to the 20th century, the area comprising the District was burned by frequent (0 – 35 year intervals) low-severity fires by natural and human ignitions. Recurring fire helped maintain healthy ecosystems and kept the landscape in more open stand condition. Clearing for settlement and logging practices of the late 1800s and early 1900s followed by an aggressive fire suppression program over much of the last century have, among other things, led to significantly higher stem densities, increased forest biomass and have allowed shade-tolerant and fire-intolerant tree species to become more common in the understory. (Foti and Spetich 2004; Chapman et al 2006) These changes in structure and composition have altered how wildfires will burn from how they had burned historically.

FRCC designations on the Ozark-St. Francis National Forests have been determined through collaborative efforts with the state and other agencies. Much of the Sylamore Ranger District is in FRCC 2 or 3.

APPENDIX M:

CITED MATERIAL/REFERENCES

Cited Literature and References

A

A'Bear, A. D., Boddy, L. & Jones, T. H. (2012). Impacts of elevated temperature on the growth and functioning of decomposer fungi are influenced by grazing collembola. Global Change Biology, 18, 1823 – 1832.

Agee, J.K. 1993. Fire ecology of Pacific Northwest Forests. Island Press, Wash. DC.

Alexander, S.A.; Anderson, R.L. 1985. How-to: identify and control annosus root rot in the South. Forestry Bulletin R8-FB/P 19. Atlanta, GA: United States Department of Agriculture, Forest Service, Southern Region. Pamphlet.

Alexander, Heather D.; Mary A. Arthur; David L. Loftis, and Stephanie R. Green. 2008. Survival and growth of upland oak and co-occurring competitor seedlings following single and repeated prescribed fires. Forest Ecology and Management 256 (2008) 1021-1030.
Anderson, R.L.; Price, T.; Tainter, F.H. 1995. How to identify and control Hypoxylon cankers of oaks and other hardwoods. Protection Report R8-PR 29. Atlanta, GA: United States Department of Agriculture, Forest Service, Southern Region. Pamphlet.

Angermeier, P.L., and J.R. Karr. 1984. Relationships between woody debris and fish habitat in a small warmwater stream. Transactions of the American Fisheries Society 113:716-726.

Arkansas Forestry Commission. 2002. Best Management Practices for Water Quality Protection, 60pp.
http://forestry.arkansas.gov/Services/ManageYourForests/Documents/bmpbookrevise.pdf

Arkansas Forestry Commission. 2007. Arkansas Smoke Management Guidelines: Guidelines for When to Burn and How to Manage Smoke, 8 pp.
http://forestry.arkansas.gov/Services/ManageYourForests/Documents/ArkansasVSMG.pdf

Arkansas Health Department. 2004. GIS shapefiles obtained through personal contacts for state identified water source intakes and source water protection areas.

Arkansas Natural Heritage Commission's Rare Species Search engine available online at http://www.naturalheritage.com.

Arkansas Pollution Control and Ecology Commission, 2004, Regulation 2 - Regulation Establishing Water Quality Standards for Surface Waters of the State of Arkansas.
http://www.adeq.state.ar.us/regs/default.htm

Arthur, Mary A., Heather D. Alexander, Daniel C. Dey, Callie J. Schweitzer, and David L. Loftis. 2012. Refining the Oak-Fire Hypothesis for Management of Oak-Dominated Forests of the Eastern United States. Journal of Forestry, published online March 22, 2012; http://dx.doi.org/10.5849/jof.11-080.

B

Barnes, T.A.; Van Lear, D.H. 1998. Prescribed fire effects onhardwood advance regeneration in mixed hardwood stands. Southern Journal of Applied Forestry 22: 138-142.

Barrett, S.; Havlina, D.; Jones, J.; Hann, W.; Frame, C.; Hamilton, D.; Schon, K.; Demeo, T.; Hutter, L.; and Menakis, J. 2010. Interagency Fire Regime Condition Class Guidebook. Version 3.0 [Homepage of the Interagency Fire Regime Condition Class website, USDA Forest Service, US Department of the Interior, and The Nature Conservancy]. [Online], Available: http://www.frcc.gov/.

Barry, P.J.; Doggett, C.; Anderson, R.L.; Swain, K.M. 1998. How to evaluate and manage storm-damaged forest areas. Management Bulletin R8-MB-63. Atlanta, GA: United States Department of Agriculture, Forest Service, Southern Region. 11p.

Benke, A. C., R. L. Henry III, D. M. Gillespie, and R.J. Hunter. 1985. Importance of snag habitat for animal production in southeastern streams. Fisheries 10:8-13.

Biasutti, M., Sobel, A. H., Camargo, S. J., & Creyts, T. T.. 2011. Projected changes in the physical climate of the Gulf Coast and Caribbean. Climatic Change, early online, 1-27. doi:10.1007/s10584-011-0254-y

Bjornn, T. C., M. A. Brusven, M. P. Molnau, J. H. Milligan, R. A. Klamt, E. Chacho, and C. Schaye. 1977. Transportation of granitic sediment in streams and its effects on insects and fish. Forest, Wildlife, and Range Station. Technical Report, Project B-036-IDA.

Bonnot, Thomas W. et. al. (2011) Biological Conservation 144 pp 2041-2053. Extension of landscape-based population viability models to ecoregional scales for conservation planning.

Brack, V., Jr. 1983. The non-hibernating ecology of bats in Indiana with emphasis on the endangered Indiana bat, *Myotis sodalis*. Dissertation. Purdue University, West Lafayette, IN. 280 pp.

Brack, V., Jr. and R.K. LaVal. 1985. Food habits of the Indiana bat in Missouri. Journal of Mammalogy 66:308-315.

Brack, V. Jr. 2006. Autumn activities of *Myotis sodalis* (Indiana bat) in Bland County, Virginia. Northeastern Naturalist 13(3):421-434.

Bragg, Don C., Michael G. Shelton, and Boris Zeide. 2003. Impacts and management implications of ice storms on forests in the southern United States. Forest Ecology and Management 186 (2003) 99-123.

Brender, Ernest V; Cooper, Robert W 1968. Prescribed burning in Georgia'sPiedmont loblolly pine stands. Journal of Forestry. 66: 31-36. Cited in Stanturf, D.A., D.D. Wade, T.A. Waldrop, D.K. Kennard, and G.L. Achtemeier. P. 607-630 (Chapter 25) In: Wear, D.M. and Greis, J. editors. 2002. Southern Forest Resource Assessment. Gen. Tech. Rep. SRS-53. Asheville, N.C.: U.S. Dept. Agric., Forest Service. Southern Research Station.

Brewer, J. Stephen; Chrisine A. Bertz, Jeffery B. Cannon, Jason D. Chesser, and Erynn E. Maynard. 2012. Do natural disturbances or the forestry practices that follow them convert forests to early-successional communities? Ecological Applications, 22 (2), 2012, pp. 442-458. http://www.frames.gov/partner-sites/frcc/frcc-home/

Brose, P. [2004 In press]. Fitting fire into oak management. In: Spetich,M.A., ed. Upland oak ecology symposium: history, current conditions, and sustainability. Gen. Tech. Rep. Asheville, NC: U.S. Department of Agriculture, Forest Service, Southern Research Station.

Binkley, D. and Brown, T.C. 1993. Forest Practices as Nonpoint Sources of Pollution in North America. Water Resource Bulletin. 29(5): 729-740.

Binkley, D. and L. MacDonald. 1994. Forests as Nonpoint Sources of Pollution, and Effectiveness of Best Management Practices. NCASI Tech. Bulletin 672. National Council of the Paper Industry for Air and Stream Improvements.

Brooks, M.L., C.M. D'Antonion, D.M. Richardson, J.B. Grace, J.E. Keeley, J.M. DiTomaso, R.J. Hobbs, M. Pellant, and D. Pyle. 2004. Effects of Invasive Alien Plants on Fire Regime. BioScience, 54: 677-688.

Brose, Patrick H. and David H. Van Lear. 1998. Responses of hardwood advance regeneration to seasonal prescribed fires in oak-dominated shelterwood stands. Can. J. For. Res. 28: 331-339.

Bukenhofer, G A. and L. D. Hedrick. 1997. Shortleaf pine/bluestem grass ecosystem renewal in the Ouachita Mountains. Trans. N. Am. Wildlife Nat. Res. Conf. 62:509-515.

Buse, M.D. and DeBano, L.F. 2005. P. 73-91 (Chapter 4: Soil Biology) In: Neary, D.G., Ryan, K.C., and DeBano, L.F. editors. 2005. Wildland Fire in Ecosystems, Effects of Fire on Soil and

Water. General Technical Report RMRS-GTR-42- volume 4. U.S. Dept. Agric., Forest Service. Rocky Mountain Research Station.

Butnor, John R., ed. 2012. Proceedings of the 16th biennial southern silvicultural research conference. e-Gen. Tech. Rep. SRS-156. Asheville,NC: U.S. Department of Agriculture Forest Service, Southern Research Station. 393 p.

C

Carter, M. C., and Foster, C. D. 2004. Prescribed burning and productivity in southern pine forests: a review. Forest Ecology and Management 191 (2004) 93-109.

Central Hardwoods Joint Venture Strategic Plan available at (http://www.chv.org/CHJV_Strategic_Plan.html)

Chapman, Ruth Ann; Eric Heitzman, Michael G. Shelton. 2006. Long-term changes in forest structure and species composition of an upland oak forest in Arkansas. Forest Ecology and Management 236 (2006) 85-92.

Clingenpeel, A.J., and Crump, M.A. 2005. A Manual for the Water Resources Analysis for Cumulative Effects v.1 analysis tool., Unpublished Process Paper, Planning Files. OSFNF Supervisor's Office.

Cole Development Group 2013. COLE 1605(b) Report for Arkansas Filtered for Administrative Forest Code: Ozark and St. Francis; Owner: National Forest; Ownership Group: Forest Service

Collins, C. S., R. N. Conner, and D. Saenz. 2002. Influence of hardwood midstory and pine species on pine bole arthropods. Forest Ecology and Management 164:211-220.

Connor MD, Wilkinson RC. 1983. Ips Bark Beetles in the South. Pineville (LA): USDA Forest Service Forest Health Protection. Forest Insect and Disease Leaflet No. 129.

Cox W. Andrew et. al. (2012) Landscape Ecol. 27:659-669. Landscape forest cover and edge effects on songbird nest predation vary by nest predator.

Cushwa et al 1971 cited in Stanturf, D.A., D.D. Wade, T.A. Waldrop, D.K. Kennard, and G.L. Achtemeier. P. 607-630 (Chapter 25) In: Wear, D.M. and Greis, J. editors. 2002. Southern Forest Resource Assessment. Gen. Tech. Rep. SRS-53. Asheville, N.C.: U.S. Dept. Agric., Forest Service. Southern Research Station.

D

Dauwalter, D. C., E. J. Edmund, and W. E. Keith. 2003. An Index of Biotic Integrity for Fish Assemblages in Ozark Highland Streams of Arkansas. Southeastern Naturalist 2(3): 447-468.

DeBano, L.F., Neary, D.G., and Folliot, P.F. 2005. P. 29-51 (Chapter 2: Soil Physical Properties). In: Neary, D.G., Ryan, K.C., and DeBano, L.F. editors. 2005. Wildland Fire in Ecosystems, Effects of Fire on Soil and Water. General Technical Report RMRS-GTR-42-volume 4. U.S. Dept. Agric., Forest Service. Rocky Mountain Research Station.

Dey, D.C; Fan, Z. 2009. A review of fire and oak regeneration and overstory recruitment. In: Hutchinson, T.F. [ed] Proceedings of the 3rd Fire in Eastern Oak Forests Conference; 2008 may 20-22; Carbondale, IL. NRS-GTR-P-46. Newtown Square, PA: USDA Forest Service, Northern Research Station: 2-20.

Dey, Daniel C.; Stambaugh, Michael C.; Clark, Stacy L.; Schweitzer, Callie J., eds.2012. Proceedings of the 4th fire in eastern oak forests conference; 2011 May 17-19; Springfield, MO. Gen. Tech. Rep. NRS-P-102. Newtown Square, PA: U.S. Department of Agriculture, Forest Service, Northern Research Station.
292 p.

Dissmeyer, G.E., and Stump, R.F. 1978. Predicted erosion rates for forest management activities in the southeast. 1978. U.S. Dept. Agric. Forest Service. State and Private Forestry Southeast Area. 26p.

Dolloff, C. A. 1996. Large woody debris, fish habitat, and historical land use. Pages 130-138 in J. W. McMinn and D. A. Crossley, Jr., editors. Biodiversity and course woody debris in southern forests. Proceedings of the workshop on coarse woody debris in southern forests: effects on biodiversity. USDA Forest Service, Southern Research Station, General Technical Report GTR-SE-094.

Donley DE, Acciavatti RE. 1980. Red Oak Borer. Delaware (OH): USDA Forest Service Northeastern Forest Experiment Station. Forest Insect and Disease Leaflet No. 163

Durkin, P.R. 2011a Glyphosate. Human Health and Ecological Risk Assessment Final Report. Syracuse Environmental Research Associates, Inc. Manlius, N.Y. 336p. http://www.fs.fed.us/foresthealth/pesticide/risk.shtml Accessed 9/20/2012.

Durkin, P.R. 2011b Triclopyr- Revised Human Health and Ecological Risk Assessment Final Report. 267 p. Syracuse Environmental Research Associates. Inc. Manlius, N.Y. 215 p. http://www.fs.fed.us/foresthealth/pesticide/risk.shtml Accessed 9/20/2012.

Durkin, P.R. 2011c Imazapyr-Human Health and Ecological Risk Assessment Final Report. Syracuse Environmental Research Associates. Inc. Manlius, N.Y. 215 p. http://www.fs.fed.us/foresthealth/pesticide/risk.shtml Accessed 9/20/2012.

Dzomba, Thomas; Story, Mark. 2005 Smoke NEPA Guidance, Describing Air Resource Impacts from Prescribed Fire on National Forests & Grasslands of Montana, Idaho, North Dakota, & South Dakota in Regions 1 & 4. USDA Forest Service. http://www.fs.fed.us/**air**/documents/Smoke%20NEPA_**2005**_Nov.pdf

F

Fox, Thomas R., Carola A. Haas, David W. Smith, David L. Loftis, Shepard M. Zedaker, Robert H. Jones, and A.L. Hammett. 2006. Alternative Silvicultural Practices in Appalachian Forest Ecosystems: Implications for Species Diversity, Ecosystem Resilience, and Commercial Timber Production in Proceedings of the 15th Central Hardwood Forest Conference. Buckley, David S.; Clatterbuck, Wayne K.; [editors] e-General Technical Report SRS-101. USDA, Forest Service Southern Research Station 770 p. Available at http://www.srs.fs.usda.gov/pubs/gtr/gtr_srs101.pdf .

Foti, Thomas L. 2004. Upland Hardwood Forests and Related Communities of the Arkansas Ozarks in the Early 19th Century in Spetich, Martin A. [editor]. 2004. Upland oak ecology symposium: history, current conditions, and sustainability. Gen. Tech. Rep. SRS-73. Asheville, NC:U.S. Department of Agriculture, Forest Service, Southern Research Station. 311 p.

Fulton, S. and B. West. 2002. Forestry Impacts on Water Quality In: Wear, D.N. and Greis, J.G., eds. 2002. Southern Forest Resource Assessment. GTR SRS-53. Ashville, NC: USDA, FS, SRS, 635 p.

G

Gaines, G. D. and E. Morris. 1996. The southern national forest's migratory and resident landbird conservation strategy. Southern Region, Forest Service, U.S. Department of Agriculture.

Gauthier, M. –M. & Jacobs, D. F. 2011. Walnut (Juglans spp.) ecophysiology in response to environmental stresses and potential acclimation to climate change. Annals of Forest Science, 68(8), 1277-1290. doi: 10.1007/s13595-011-0135-6

Goebel et al 1967 cited in Stanturf, D.A., D.D. Wade, T.A. Waldrop, D.K. Kennard, and G.L. Achtemeier. P. 607-630 (Chapter 25) In: Wear, D.M. and Greis, J. editors. 2002. Southern Forest Resource Assessment. Gen. Tech. Rep. SRS-53. Asheville, N.C.: U.S. Dept. Agric., Forest Service. Southern Research Station.

Graening, G.O et al 2003. Subterranean Biodiversity of Arkansas Part 1. Bioinventory and Bioassessment of Caves in the Sylamore Ranger District, Ozark National Forest, Arkansas.

Journal of the Arkasas Academy of Science. Volume 57, 2003.

Greenberg, Cathryn H., Tara L. Keyser, Stanley J. Zarnoch, Kristina Connor, Dean M. Simon and Gordon S. Warburton. 2012. Acorn viability following prescribed fire in upland hardwood forests. Forest Ecology and Management 275 (2012) 79-86.

Gregory, S, K. Boyer, and A. Gurnell. 2003. The Ecology and Management of Wood in World Rivers. American Fisheries Society Symposium 37.

Gu, L., Hanson, P. J., Post, W. M., Kaiser, D. P., Yang, B., Nemani, R., Pallardy, S. G., and Meyers, T. (2008). The 2007 Eastern US spring freeze: Increased cold damage in a warming world. BioScience, 58(3), 253-262. doi:10.1641/B580311

Gutowski, W.J., G.C. Hegerl, G.J. Holland, T.R. Knutson, L.O. Mearns, R.J. Stouffer, P.J. Webster, M.F. Wehner, and F.W. Zwiers, 2008: Causes of observed changes in extremes and projections of future changes. In: Weather and Climate Extremes in a Changing Climate: Regions of Focus: North America, Hawaii, Caribbean, and U.S. Pacific Islands [Karl, T.R., G.A. Meehl, C.D. Miller, S.J. Hassol, A.M. Waple, and W.L. Murray (eds.)]. Synthesis and Assessment Product 3.3. U.S. Climate Change Science Program, Washington, DC, pp. 81-116.

Guyette, R.P. and Spetich, M.A. 2003. Fire History of Oak-Pine Forests in the Lower Boston Mountains, Arkansas, USA. *Forest Ecology and Management*. 180: 463-474.

Guyette, R.P.; Spetich, M.A.; and Stambaugh, M.C. 2006. Historic fire regime dynamics and forcing factors in the Boston Mountains, Arkansas, USA. *Forest Ecology and Management*, 234: 293-303.

H

Haavik, L. J., Stahle, D. W., & Stephen, F. M. (2011). Temporal aspects of Quercus rubra decline and relationship to climate in the Ozark and Ouachita Mountains, Arkansas. Canadian Journal of Forest Research, 41(4), 773-781. doi: 10.1139/x11-018

Haavik, Laurel J.; Joshua S. Jones, Larry D. Galligan, James M. Guldin and Fred M. Stephen. 2012. Oak decline and red oak borer outbreak: impact in upland oak-hickory forests of Arkansas, USA. Forestry, doi:10, 1093/cps032. Downloaded from http://forestry.oxfordjournals.org/at DigiTop USDA's Desktop Library on August 9, 2012

Hann, W.J., Bunnell, D.L. 2001. Fire and land management planning and implementation across multiple scales. Int. J. Wildland Fire. 10:389-403.

Hann, W.J.; and D.J. Strohm. 2003. Fire Regime Condition Class and Associated Data for Fire and Fuels Planning: Methods and Applications in USDA Forest Service Proceedings RMRS P-29.

Hardy, Colin C.; Ottmar, Roger, D; Peterson, Janice L., Core, John E., and Seamon, Paula. 2001. Smoke Management Guide for Prescribed and Wildland Fire. National Wildfire Coordination Group. 226 p. http://www.nwcg.gov/pms/pubs/SMG/SMG-72.pdf

Hayhoe, K., D. Wuebbles, and the Climate Science Team, 2008: Climate Change and Chicago: Projections and Potential Impacts. City of Chicago, [175 pp.] http://www.chicagoclimateaction.org/

Hayhoe, K., VanDorn, J., Corley II, T., Schlegal, N., Wuebbles, D., 2010. Regional climate change projections for Chicago and the US Great Lakes. Journal of Great Lakes Research 36, 7–21.

Hewlett, J.D. 1982. Principles of Forest Hydrology, University of Georgia Press. 183 pages

Hough,W.A., 1981. Impact of prescribed fire on understory and forest floor nutrients. USDA For. Serv. Res. Note SE-RN-363. 4 pp. Cited in: Carter, M.C., and Foster, C. D. Prescribed Burning and productivity in southern pine forests: a review. Forest Ecology and Management 191 (2004) 93-109.

Humphrey, S.R., A.R. Richter, and J.B. Cope. 1977. Summer habitat and ecology of the endangered Indiana bat, *Myotis sodalis*. Journal of Mammalogy 58:334-346.

Hutchinson, Todd F.; Robert P. Long, Joanne Rebbeck, Elaine Kennedy Sutherland, and Daniel A. Yaussy. 2012a. Repeated prescribed fires alter gap-phase regeneration in mixed-oak forests. Can. J. For. Res. 42: 303-314 (2012)

Hutchinson, Todd F.; Daniel A. Yaussy, Robert P. Long, Joanne Rebbeck, Elaine Kennedy Sutherland. 2012b. Long term (13-year) effects of repeated prescribed fires on stand structure and tree regeneration in mixed-oak forests. Forest Ecology and Management 286 (2012) 87-100.

I

Intergovernmental Panel on Climate Change. 2007. Climate Change 2007: Synthesis Report, Geneva. http://www.ipcc.ch/publications_and_data/ar4/syr/en/mains3.html#3-1 (Accessed April 11, 2013)

J

Jha, M., Pan, Z., Takle, E. S., & Gu, R. (2004). Impacts of climate change on streamflow in the Upper Mississippi River Basin: A regional climate model perspective. Journal of Geophysical Research, 109, D09105. doi:10.1029/2003JD003686

Jha, M., J.G. Arnold, P.W. Grassman, F. Giorgi, and R.R. Gu, 2006. Climate Change Sensitivity Assessment on Upper Mississippi Basin Streamflows Using SWAT. Journal of the American Water Resources Association. 42(4):997-1016.

Johnson, Joshua B.; Ford, W. Mark; Rodrigue, Jane L.; Edwards, John W.; Johnson, Catherine. 2010. Roost selection by male Indiana Myotis following forest fires in central Appalachian hardwoods forests. Journal of Fish and Wildlife Management. 1(2): 111-121.

Joyce, L. A., Blate, G. M., Littell, J. S., McNulty, S. G., Millar, C. I., Moser, S. C., Peterson, D. L. (2008). National forests. in: Preliminary review of adaptation options for climate-sensitive ecosystems and resources. a report by the U.S. climate change science program and the subcommittee on global change research. U.S.Environmental Protection Agency, 1-127.

Jurney, D.H., R. Evans, J. Ippolito, and V. Bergstrom 2004. The Role of Wildland Fire in Portions of Southeastern North America. Proceedings of the 22nd Tall Timbers Fire Ecology Conference: Fire in Temperate, Boreal, and Montane Ecosystems, Alberta Canada 15-18 October 2001. pp. 95-116.

Jurney, D.H., G. Knudsen, M. Pfeiffer, and T. Foti. 2010. Heritage Resources Overview: Ozark-St. Francis National Forests, Arkansas. Heritage Resources Inventory Report Series 09-10-08-01. Russellville.

Jurney, D.H. 2012. Anthropology of Fire in the Ozark Highland Region. In D.C. Dey, M.C. Stambaugh, S.L. Clark, C.J. Schuitzer (eds). Proceedings of the 4th Fire in Eastern Oaks Conference, Springfield, MO, 2011, pp. 12-33. General Technical Report-Northern Research Station-P-102.

Jurney, D.H. and R.S. McCluskey 2012. Indiana Bat Environmental Assessment, Sylamore Ranger District, Baxter and Stone Counties, Arkansas. Heritage Inventory Report Series 12-10-01-01. Ozark-St. Francis National Forest, Russellville, Arkansas.

K

Karl, T.R. and R.W. Knight, 1998: Secular trends of precipitation amount, frequency, and intensity in the United States. Bulletin of the American Metrological Society, 79(2), 231-241.

Karl, T. R., Melillo, J. M., & Peterson, T. C. (2009). Global climate change impacts in the United States. New York, NY, USA: Cambridge University Press.
Keim, B. D., 1997. Preliminary analysis of the temporal patterns of heavy rainfall across the southeastern United States. Professional Geographer, 49(1), 94-104.

Knoepp, J.D., DeBano, L.F., and Neary, D.G. 2005. P. 53-71. (Chapter 3: Soil Chemistry). In: Neary, D.G., Ryan, K.C., and DeBano, L.F. editors. 2005. Wildland Fire in Ecosystems, Effects of Fire on Soil and Water. General Technical Report RMRS-GTR-42- volume 4. U.S. Dept. Agric., Forest Service. Rocky Mountain Research Station.

Knox, J. C. 1993 Large increases in flood magnitude in response to modest changes in climate. Nature 361, 430-432.

Knox, J. C. 2000 Sensitivity of modern and Holocene floods to climate change. Quat. Sci. Rev. 19, 439-457.

Kolpin, D.W., Kalkhoff, S.J., Goolsby, D.A., Sneck-Fahrer, D.A., Thurman, E.M., 1997, Occurrence of selected herbicides and herbicide degeneration products in Iowa's ground water, 1995. Groundwater, vol. 35, p. 679-688.

Kolpin, D.; Barbash, J.E.; Gillion, R.J.; 2000. Pesticides in Ground Water of the US, 1992-1996. Ground Water, Vol. 38, No. 6, November-December 2000.

Koterba, M.T., Banks, W.S.L., Shedlock, R.J., 1993. Pesticides in shallow ground water in the Delmarva Peninsula, Jounal of Environmental Quality, Vol. 22, p.500-518.

Kraemer, Martin J.; Nyland, Ralph D. 2010. Hardwood Crown Injuries and Rebuilding Following Ice Storms: A Literature Review. Northern Research Station. General Technical Report NRS-60.

Kunkel, K.E., P.D. Bromirski, H.E. Brooks, T. Cavazos, A.V. Douglas, D.R. Easterling, K.A. Emanuel, P.Ya. Groisman, G.J. Holland, T.R. Knutson, J.P. Kossin, P.D. Komar, D.H. Levinson, and R.L. Smith, 2008: Observed changes in weather and climate extremes. In: Weather and Climate Extremes in a Changing Climate: Regions of Focus: North America, Hawaii, Caribbean, and U.S. Pacific Islands [Karl, T.R., G.A. Meehl, C.D. Miller, S.J. Hassol, A.M. Waple, and W.L. Murray (eds.)]. Synthesis and Assessment Product 3.3. U.S. Climate Change Science Program, Washington, DC, pp. 35-80.

Kurta, A. and J.O. Whitaker, Jr. 1998. Diet of the endangered Indiana bat (*Myotis sodalis*) on the northern edge of its range. American Midland Naturalist 140:280-286.

L

Lavdas, Leonidas G. 1996. Program V-Smoke Users Manual. Gen. Tech. Rep. SRS-6. Asheville, NC; USDA Forest Service, Southern Research Station. 147p.

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 Hileman L.H., 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.

Leonard, M., J. Yowell, C. Roghair, D. Nuckols, and C. A. Dolloff. 2005. Stream Habitat Distribution in the North Sylamore Creek Drainage, Ozark National Forest, AR, 2004. USDA Forest Service, Southern Research Station, Center for Aquatic Technology Transfer, Blacksburg, Virginia. Unpublished Report.

Lettenmaier, D. P., et al., 1999: Water resources implications of global warming: A US regional perspective, Climatic Change, 43, 537-579.

Lhotka, John M. and Edward F. Lowenstein. 2011. An individual-tree diameter growth model for managed uneven-aged oak-shortleaf pine stands in the Ozark Highlands of Missouri, USA. Forest Ecology and Management 261 (2011) 770-778.

Liechty, H.O., Sawyer, V. L., and Shelton, M. G. Alteration of nutrient status by manipulation of composition and density in a shortleaf pine-hardwood stand. In: Outcalt, K. W., ed. 2002a. Proceedings of the eleventh biennial southern silvicultural research conference. Gen. Tech. Rep. SRS-48. Asheville, N.C., U.S. Dept. Agric. Forest Service Southern Research Station. 622p. pp. 10-14.

Liechty, H. O., Shelton, M. G., Luckow, K. R., and Turton, D. J. Impacts of shortleaf pine-hardwood forest management on soils in the Ouachita Highlands: A Review. Southern Journal of Applied Forestry. 26 (1) 2002b p. 43-51.

Liechty, H.O.; Luckow, K.R; Seifert, J.; Marion, D.A.; Spetich, M.; Guldin, J.M. 2004. Shortleaf Pine Ecosystem Restoration: Impacts on Soils and Woody Debris in the Ouachita Mountains of the Southern United States. 16th Int'l Conference, Society for Ecological Restoration, August 24-26, 2004. Victoria, Canada.

Luensmann, Peggy 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/ [2013, February 22].

Lynch, J.A; E.S. Corbett. 1990. Evaluation of Best Management Practices for Controlling Non-point Pollution from Silvicultural Operations. Water Resour. Bull. 26 (1): 41-52 ins Proceedings of the 8th Central Hardwood forest Conference. University Park, Pennsylvania. March 4-6, 1991. Gen. Tech. Rep. NE 148. Northeast Forest Experimental Station.

M

Malmsheimer, Heffernan, Brink et al 2008. Forest Management Solutions for Mitigating Climate Change in the United States. Journal of Forestry. Vol 106, No. 3 (April/May 2008).

Marion, D.A.. 2004. Personal Communications – Effects of Prescribed Burning on water quality in the Ouachita Mountains, memo, SO unpublished.

Matthews et al. 2007a. The Bird Atlas. http://nrs.fs.fed.us/atlas/bird/index.html#)

Matthews, S.N., L. R. Iverson, A.M. Prasad, A. M., and M.P. Peters. 2007b. Ongoing. A Climate Change Atlas for 147 Bird Species of the Eastern United States [database]. http://www.nrs.fs.fed.us/atlas/bird, Northern Research Station, USDA Forest Service, Delaware, Ohio.

Maxwell J.R. and Neary, D.G. 1991. vegetation management effects on sediment yields. P. 12/55 – 12/63 in Shou-Shou, T., Yung-Huang, K. (Eds.) Proceedings of the 5th federal interagency sedimentation conference, volume 2, 18-2, March, Las Vegas, NV. Federal Energy Regulatory Commission, Washington D.C.

McFarland, J.D., 2004 (revised), Stratigraphic Summary of Arkansas: Arkansas Geological Commission, Information Circular 36

McKenney, D. W., Pedlar, J. H., Lawrence, K., Campbell, K., & Hutchinson, M. F. (2007). Potential impacts of climate change on the distribution of North American trees. BioScience, 57(11), 939-948.

McMahon and Bush. 1992. cited in **Bush, P.B., Neary, D.G., and McMahon, C.K. 2000.** Fire and Pesticides: Air Quality Considerations. http://www.bugwood.org/factsheets/98-021.html .

McMahon, Charles K.; James H. Miller, and David F. Thomas. 1993. The Role of Low Impact Herbicide Treatments in Ecosystem Management in Foley, Louise H., Comp. 1994. Silviculture: From the Cradle of Forestry to ecosystem management, proceedings of the National Silviculture Workshop; 1993 November 1-4; Hendersonville, NC, GTR SE-88. Asheville, NC. USDA, forest Service, Southeastern Forest Experiment Station: 242-251.

Meyer, J. L. 1992. `Seasonal patterns of water quality in blackwater rivers of the Coastal Plain, Southeastern United States', in Becker, C. D. and Neitzel, D. A. (Eds), Water Quality in North American River Systems. Batelle Press, Columbus. pp. 249-276.

Michael, J.; Neary D. 1993. Herbicide Dissipation Studies in Southern Forest Ecosystems. Environmental Toxicology and Chemistry, 12 (1993):4045-410.

Michael, J.L., Gibbs, H.L., Fischer, J.B.; Webber, E.C., 2000. Protecting surface water systems on forest sites through herbicide use, in Proceedings Xth World water congress: "water" the worlds most important resource, march, Melbourne, Australia.

Millar, Constance I., Nathan L. Stephenson and Scott L. Stephens. 2007. Climate Change and Forests of the Future: Managing in the Face of Uncertainty. Ecological Applications 17(8): 2145-2151.

Miller E.L., and H.O. Leichty. 2001. Forest Inventory and Analysis: What it tells us about water quality in Arkansas. In proceedings of the symposium on Arkansas Forests: a conference on the results of the recent forest survey of Arkansas; ed. Gouldin, J.M., 1997. North Little Rock, AR. USDA GTR-SRS-41, 125p.

Miller, R. E., S.R. Colbert, and L. A. Morris. 2004. Effects of heavy equipment on physical properties of soils and long-term productivity: a review of literature and current research. NCASI Tech. Bull. No. 887, October, 76 p.

Miller, James 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 .

Miller, J.H., E.B. Chambliss, and N.J. Loewenstein. 2010a. A Field Guide for the Identification of Invasive Plants in Southern Forests. Forest Service Southern Research Station General Report SRS-119

Miller, J.H., S.T. Manning, and S.F. Enloe. 2010b. A Management Guide for Invasive Plants in Southern Forests. United States Department of Agriculture. Forest Service Southern Research Station General Technical Report SRS-131.

Molano-Flores, B. & Bell, T. J. (2012). Projected population dynamics for a federally endangered plant under different climate change emission scenarios. Biological Conservation, 145(1), 130-138. doi:10.1016/j.biocon.2011.10.022

Moulton II, S. R. and K. W. Stewart. 1996. Caddisflies (Trichoptera) of the Interior Highlands of North America. Memoirs of the American Entomological Institute: The American Entomological Institute, volume 56.

Mulholland, P. J., Best, G. R., Coutant, C. C., Hornberger, G. M., Meyer, J. L., Robinson, P. J, Stenberg, J. R., … & Wetzel, R. G. (1997). Effects of climate change on freshwater ecosystems of the south-eastern United States and the Gulf Coast of Mexico. Hydrological Processes, 11, 949-970. doi: 10.1002/(SICI)1099-1085 (19970630)11:8<949::AID-HYP513>3.0.CO;2-G

Murray, S.W. and A. Kurta. 2002. Spatial and temporal variation in diet. Pp. 182-192 *in* A. Kurta and J. Kennedy (eds.), The Indiana bat: biology and management of an endangered species. Bat Conservation International, Austin, TX.

N

Nakicenovic, N. et al., 2000. IPCC special report on emissions scenarios. Cambridge University Press, Cambridge, UK

National Drought Mitigation Center. 2012. Maps depicting broad-scale drought conditions nation-wide and in the south. http://droughtmonitor.unl.edu as of August 28, 2012.

Neary, D.G.. 1985. Fate of pesticides in Florida forests: an overview of potential impacts on water quality. Soil and crop science society of florida proceedings vol. 44, p.18-23.

Neary et al. 1993. Fate, dissipation, and environmental effects of pesticides in southern forests: a review of a decade of progress. Environmental Toxicology and Chemistry, vol. 12, p. 411-428.

Neary, D.G. and Michael, J.L.. 1996. Herbicides-Protecting long term sustainability and water quality in forest ecosystems, New Zealand Journal of Forestry Science, vol 26 (1/2), p. 241-264.

Nelson, Paul W. 2012. Fire-adapted natural communities of the Ozark Highlands at the time of European settlement and now. In: Dey, Daneil C.; Stambaugh, Michael C.; Clark, Stacy L.; Schweitzer, Callie J., eds. Proceedings of the 4th fire in eastern oak forests conference; 2011 May 17-19; Springfield, MO. Gen. Tech Rep. NRS-P-102. Newtown Square, PA: USDA, Forest Service, Northern Research Station: 92-102.
NOAA. HYSPLIT smoke model. http://www.arl.noaa.gov/HYSPLIT.php

O

O'Brien, J.G.; Mielke, M.E.; Starkey, D.A.; Juzwik, J. 2000. How to identify, prevent, and control oak wilt. NA-PR-03-00. 28p.

Omernik, J.M. 1987. Ecoregions of the conterminous United States. Map (scale 1:7,500,000). Annals of the Association of American Geographers 77(1): 118-125.

Omi, Philip N.; Joyce, Linda A., technical editors. 2003. Fire, fuel treatments, and ecological restoration: Conference proceedings; 2002 16-18 April; Fort Collins, CO. Proceedings RMRS-P-29. Fort Collins, CO: U.S. Department of Agriculture, Forest Service, Rocky Mountain Research Station. 475 p.

P

Page-Dumroese, D., M. F. Jurgensen, A.E. Tiarks, and others. 2006. Soil physical property changes at the North American Long-Term Soil Productivity study sites: 1 and 5 years after compaction. Can. J. For. Res. 36:551-564.

Patric, J.H. 1980. Effects of Wood Products Harvest on Forest Soil and Water Relations. Journal of Environmental Quality 9(1): 73-80

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

Pelkki, Matthew H. 2005. An Economic Assessment of Arkansas' Forest Industries: Challenges and Opportunities for the 21st Century. University of Arkansas-Monticello School of Forest Resources. Arkansas Forest Resources Center. University of Arkansas Division of Agriculture. Arkansas Agricultural Experiment Station. Fayetteville, AR.

Petersen, J. C. 2004. Fish Communities of the Buffalo River Basin and Nearby Basins of Arkansas and Their Relation to Selected Environmental Factors, 2001-2002. U.S. Department of the Interior, U.S. Geological Survey, Scientific Investigations Report 2004-5119.

Poff, N. L. (2002). Ecological response to and management of increased flooding caused by climate change. Philosophical Transactions of the Royal Society of London A, 360, 1497 – 1510. 10.1098/rsta.2002.1012

Powers, R.F., D.H. Alban, R.E. Miller, A.E. Tiarks, C.G. Wells, P.E. Avers, R.G. Cline, R.O. Fitzgerald, and N.S. Loftus, Jr. 1990. Sustaining site productivity in north American forests: problems and prospects. P. 49-79. 1990. In: S.P. Gessel, D.S. Lacate, G.F. Weetman, and R.F. Powers. Sustained productivity of forest soils. Proceedings of the 7th North American forest soils conference. University of British Columbia. Faculty of Forestry Publication. Vancouver, B.C. 525p.

Powers, R. F., A.E. Tiarks, and J.R. Boyle. 1998. Assessing soil quality: practical standards for sustainable forest productivity in the United States. In: The contribution of soil science to the development and implementation of criteria and indicators of sustainable forest management. SSSA Spec. Publ. 53. Madison, WI SSA:53-80 Cited in: Page-Diumroese, D., D.G. Neary, and C. Trettin. Compilers. 2008. Scientific background for soil monitoring on national forests and rangelands. Workshop Proceedings, April 29-30. 2008. Denver, CO. RMRS-P-59.

Powers, R.F. 2002. Effects of soil disturbance on the fundamental, sustainable productivity of managed forests. In: U.S.D.A. Forest Service Gen. Tech. Rep. PSW-GTR_183. 2002. P. 63-82.

Powers, R. F., D. A. Scott, F.G. Sanchez, R.A. Voldseth, D. Page-Dumroese, and J.D. Elioff. 2005. The North American Long-Term Soil Productivity experiment: findings from the first decade of research. For. Ecol. and Mgmt. 2220:31-50.

Powers, R. F., 2006. Long-term soil productivity: genesis of the concept and principles behind the program. Can. J. For. Res. 36: 519-528.

Prasad, A. M., L. R. Iverson., S. Matthews., M. Peters. 2007-ongoing. A Climate Change Atlas for 134 Forest Tree Species of the Eastern United States [database]. http://www.nrs.fs.fed.us/atlas/tree, Northern Research Station, USDA Forest Service, Delaware, Ohio.

Q

R

Raison, R.J., Khanna, P.K., Woods, P.V., 1985a. Mechanisms of element transfer to the atmosphere during vegetation fires. Can. J. For. Res. 15, 132–140. Cited in: Carter, M.C., and Foster, C. D. Prescribed Burning and productivity in southern pine forests: a review. Forest Ecology and Management 191 (2004) 93-109.

Reed 1939 cited in **Bragg, Don C., Michael G. Shelton, and Boris Zeide. 2003.** Impacts and management implications of ice storms on forests in the southern United States. Forest Ecology and Management 186 (2003) 99-123.

Reid, L.M. Cumulative watershed effects: Casper Creek and beyond. USDA Forest Service PSW-GTR-168, p. 117-127.

Relyea, C. D., G. W. Minshall, and R. J. Danehy. 2000. Stream Insects as Bioindicators of Fine Sediment. Watershed Management 2000 Conference.

Renken, R.A., 1998. USGS Publication HA 730-F, Ground Water Atlas fo the United States: Arkansas, Louisiana, Mississippi. Reston, VA., 28p.

Renschin, M.L., H.O. Liechty, and M.G. Shelton. Impacts of long-term prescribed fire on decomposition and litter quality in uneven-aged loblolly pine stands. P. 119-122. In: Outcalt, Kenneth W. ed. 2002. Proceedings of the eleventh biennial southern silvicultural research conference. Gen. Tech. Rep. SRS-48. Asheville, N.C. : U.S.D.A. Forest Service Southern Research Station 622p.

Rentch, James S.; Mary and Fajvan, Ray R. Hicks, Jr. 2003. Oak establishment and canopy accession strategies in five old growth stands in the central hardwood forest region. Forest Ecology and Management 184 (2003) 285-297.

Rexrode, C.O.; Brown, D. 1983. Oak Wilt. Forest Insect & Disease Leaflet 29. Washington, DC: United States Department of Agriculture, Forest Service.

Rhoads, Anne G.; Hamburg, Steven P; Fahey, Timothy J.; Siccama, Thomas G.; Hane, Elizabeth N.; Battles, John; Cogbill, Jesse Randall; and Wilson, Geoff. 2002. Effects of an intense ice storm on the structure of a northern hardwood forest. Canadian Journal of Forest Research. October 2002, Vol. 32, Issue 10, p 1763.

Ribe, R. G. (1989). The aesthetics of forestry: What has empirical preferene research taught us? *Environmental Management*, 55-74.

Richardson, D.M, P. Pysek, M. Rejmánek, M.G. Barbour, F.D. Panetta, and C.J. West. 2000. Naturalization and Invasion of Alien Plants: Concepts and Definitions. Diversity and Distributions 6:93-107.

Rieske, L.K. 2002. Wildfire alters oak growth, foliar chemistry and herbivory. Forest Ecology and Management 168 (2002) 91-99.

Robison, H. W. 2000. Crayfishes of the Sylamore and St. Francis Ranger Districts, Ozark National Forest, Arkansas. USDA Forest Service, Ozark National Forest, Russellville, Arkansas.

Rogers 1924 cited in **Bragg, Don C., Michael G. Shelton, and Boris Zeide. 2003.** Impacts and management implications of ice storms on forests in the southern United States. Forest Ecology and Management 186 (2003) 99-123.

Rosgen, D. 1996. Applied River Morphology. Wildland Hydrology, Pagosa Springs, Colorado.

Rudolph, D. C., and C. A. Ely. 2000. The influence of fire on lepidopteran abundance and community structure in forested habitats of eastern Texas. Texas J. Sci. 52:127-138. (refereed).

Rudolph, D. C., C. A. Ely, R. R. Schaefer, and J. H. Williamson. 2006. The Diana fritillary (*Speyeria diana*) and the great spangled fritillary (*S. cybele*): dependence on fire in the Ouachita Mountains of Arkansas. Journal of the Lepidopterists' Society 60:218-226. (refereed).

S

Sauer, J. R., J. E. Hines, and J. Fallon. 2004. The North American Breeding Bird Survey, Results and Analysis 1966 - 2003. Version 2004.1. USGS Patuxent Wildlife Research Center, Laurel, MD

Schmidt, K.M., Menakis, J.P. Hardy, C.C., Hann, W.J., Bunnell, D.L. 2002. Development of coarse-scale spatial data for wildland fire and fuel management. General Technical Report, RMRS-GTR-87, U.S. Department of Agriculture, Forest Service, Rocky Mountain Research Station, Fort Collins, CO.

Schoch, P., Binkley, D., 1986. Prescribed burning increased N availability in a mature loblolly pine stand. For. Ecol. Manage. 14, 13–22. Cited in: Carter, M.C., and Foster, C. D. Prescribed Burning and productivity in southern pine forests: a review. Forest Ecology and Management 191 (2004) 93-109.

Scoles, S.R. 1996. Forestry and Water Quality. A Review of Watershed Research in the Ouachita Mountains, Oklahoma Cooperative Extension Service. 28 pages.

Scott, Joe H.; Burgan, Robert E. 2005. Standard fire behavior fuel models: a comprehensive set for use with Rothermel's surface fire spread model. Gen. Tech. Rep. RMRS-GTR-153. Fort Collins, CO: U.S. Department of Agriculture, Forest Service, Rocky Mountain Research Station. 72 p.Smith RH, Lee RE III. 1972. Black Turpentine Beetle. Berkley (CA): USDA Forest Service Pacific Southwest Research Station. Forest Insect & Disease Leaflet No. 12.

Seager, R., Tzanova, A., & Nakamura, J. (2009). Drought in the Southeastern United States: Causes, variability over the last millennium, and the potential for future hydroclimate change. American Meteorological Society, 22(19), 5021-5045.

Shugart, H., Sedjo, R., & Sohngen, B. (2003). Forests & global climate change potential impacts on U.S. forest resources. Pew Center on Global Climate Change.

Siccama et al 1976 cited **Bragg, Don C., Michael G. Shelton, and Boris Zeide. 2003.** Impacts and management implications of ice storms on forests in the southern United States. Forest Ecology and Management 186 (2003) 99-123.

Smith, David M.; Bruce C. Larson; Matthew J. Kelty, and P. Mark S. Ashton. The Practice of Silviculture: Applied Forest Ecology, 9th Edition. pp 214-217. John Wiley and Sons, Inc.

Sobolowski, S. & Pavelsky, T. (2012). Evaluation of present and future North American Regional Climate Change Assessment Program (NARCCAP) regional climate simulations over the southeast United States. Journal of Geophysical Research, 117(D1), D01101+. doi: 10.1029/2011JD016430

Soucy, R. , E Heitzman, M Spetich. 2005. The establishment and development of oak forests in the Ozark Mountains of Arkansas. Can. J. For. Res. 35: 1790-1797 (2005) pp 1790 -1797.

Spetich, Martin A. [editor]. 2004. Upland oak ecology symposium: history, current conditions, and sustainability. Gen. Tech. Rep. SRS-73. Asheville, NC:U.S. Department of Agriculture, Forest Service, Southern Research Station. 311 p.

Spetich, Martin A. 2006 Early changes in physical tree Characteristics during an oak decline event in the Ozark Highlands in Connor, Kristina F., ed. 2006. Proceedings of the 13th biennial southern silvicultural research conference.Gen. Tech. Rep. SRS–92. Asheville, NC: U.S. Department of Agriculture, Forest Service, Southern Research Station. 640 p.

Spetich, MA; R.W. Perry; C. Harper; S.L. Clark., 2011a. Fire in Eastern Hardwood Forests through 14,000 Years. Book Chapter in Ecology and Management of Early Successional Habitats in Eastern Hardwood Forests. Springer. p41-58.

Spetich, Martin A., Zhaofie Fan, Hong He, Stephen R. Shifely, and W. Keith Moser 2011b. Forest Health Monitoring National Technical Report August 26, 2011**.** Chapter 13. Risk Factors for Oak Decline and Regional Mortality Patterns in the Ozark Highlands of Arkansas and Missouri (project SO-EM-06-04)

Stambaugh, Michael; Richard Guyette, and Charles Putnam. 2005. Fire in the pines: A 341 year fire and human history at Big Spring Pines Natural Area, Ozark National Scenic Riverways in Park Science, Volume 23, Number 2, Fall 2005 http://www.nature.nps.gov/ParkScience/index.cfm?ArticleID=113&Page=1

Stanturf, J.A., D.D. Wade, T.A. Wade, T.A. Waldrop, D.K. Kennard, and G.L. Achtemeier. Chapter 25: Background Paper. Fire in southern landscapes. P. 607-630. In: Wear, D.M., J. Greis editors. 2002. Southern Resource Assessment. Gen. Tech. Rep. SRS-53. Asheville, N.C.: U.S. Dept. Agric. Forest Service Southern Research Station.

Starkey, D.A.; Oak, S.W.; Ryan, G.W.; Tainter, F.H.; Redmond, C.; Brown, H.D. 1989. Evaluation of oak decline areas in the South. Protection Report R8-PR-17. Atlanta, GA: United States Department of Agriculture, Forest Service, Southern Region. 36p.

Stednick, John D., 1996. Monitoring the effects of timber harvest on annual water yield. Journal of Hydrology 176 (1996) 79-95.

Stettergren, Carl D., and Krstansky, John J., 1987. Hydrograph Responses to Timber Harvesting in the Missouri Ozarks. Presented at the Sixth Central Hardwoods Conference. Knoxville, TN.

Story M. and T. Dzomba. 2005. Describing Air Resource Impacts from Prescribed Fire on National Forests & Grasslands of Montana, Idaho, North Dakota, & South Dakota in Regions 1 & 4. 30 pp. http://www.fs.fed.us/r1/gallatin/resources/air/guidance/index.shtml

Sun, G., S.G. McNulty, E. Cohen, J.M. Myers, and D. Wear, 2005: Modeling the impacts of climate change, landuse change, and human population dynamics on water availability and demands in the Southeastern US. Paper number 052219. Proceedings of the 2005 ASAE Annual Meeting, St. Joseph, MI.

Sun, G., McNulty, S. G., Moore Myers, J. A., & Cohen, E. C. (2008). Impacts of multiple stresses on water demand and supply across the southeastern United States. Journal of the American Water Resources Association, 44(6), 1441-1457. doi:10.1111/j.1752-1688.2008.00250.x

Swindel, B.F., W.M. Marion, L.D. Harris, L.A. Morris, W.L. Pritchett, L.F. Conde, H. Riekerk, and E.T. Sullivan. 1983. Multi-Resource Effects of Harvest, Site Preparation, and Planting in *Pinus elliotti* Flatwoods. Science 219: 1421-1422.

T

Thill, R.E., D.C. Rudolph, and N.E. Koerth. 2004. Shortleaf pine-bluestem restoration for red cockaded woodpeckers in the Ouachita Mountains: implications for other taxa. Pages 657-671 *in* Red-cockaded Woodpecker: road to recovery (R. Costa and S. J. Daniels, eds.). Hancock House Publishers, Blaine, WA.

Tu, M., C. Hurd, and J.M. Randall. The Nature Conservancy Weed Control Methods Handbook: Tools and Techniques for use in natural areas. 2001. Updated 2003. 219 p.

U

USDC. US Census Bureau. Census 2010. http://www.census.gov

USDA Forest Service. (n.d.). ROS Users Guide. U.S. Forest Service.

USDA Forest Service. (n.d.) Ozark-St. Francis National Forests Threat Decision Matrix for Non-native invasive plants.

USDA Forest Service. **(n.d)** Ozark-St. Francis National Forests. Pesticide Emergency Spill Plan.

USDA Forest Service Firelab, USGS, The Nature Conservancy. Landfire available at http://www.landfire.gov/index.php.

USDA Forest Service. 1995. Landscape Aesthetics: A Handbook for Scenery Management. Washington, D.C.: U.S. Forest Service.

USDA Forest Service. 1996. Ozark - St. Francis National Forests North Sylamore Creek Wild and Scenic River Management Plan. Russelville, Arkansas: U.S. Forest Service.

USDA, Southern Research Station 1999. Ozark-Ouachita Highlands Assessment: Air Quality.GTR SRS-32.

USDA, Southern Research Station. 1999. Ozark-Ouachita Highlands Assessment: GTR SRS 34.

USDA, Southern Research Station 1999. Ozark-Ouachita Highlands Assessment: Terrestrial Vegetation. Gen Tech Report SRS 35.

USDA Forest Service 2003. Region 8 Soil Quality Standards Forest Service Handbook 2509.18-2003-2. 4p.

USDA Forest Service. 2004a. National Strategy and Implementation Plan for Invasive Species Management. FS-805

USDA Forest Service. 2004b. Graham, Russell T.; McCaffrey, Sarah; Jain, Theresa B. (tech. eds.) 2004. Science basis for changing forest structure to modify wildfire behavior and severity. Gen. Tech. Rep. RMRS-GTR-120. Fort Collins, CO: U.S. Department of Agriculture, Forest Service, Rocky Mountain Research Station. 43 p. http://www.fs.fed.us/rm/pubs/rmrs_gtr120.html

USDA Forest Service 2005a. Revised Land and Resource Management Plan. Ozark-St. Francis National Forests.

USDA Forest Service 2005b. Final Environmental Impact Statement for the Revised Land and Resource Management Plan. Ozark-St. Francis National Forests.

USDA-Forest Service 2005c. Revised Land and Resource Management Plan. Ozark-St. Francis National Forests, Arkansas. Management Bulletin R8-MB 125A.

USDA Forest Service. 2005d. Programmatic agreement among U.S. Department of Agriculture, Forest Service, Ouachita National Forest, Arkansas and Oklahoma, Oklahoma State Archaeologist, the Advisory Council on Historic Preservation, and federally recognized Indian tribes, concerning the management of historic properties on National Forest Lands in Arkansas and Oklahoma (final revision 23 December 2005, 03-MU-11080901-01A, Section B)

USDA Forest Service. 2005e. North Sylamore Creek Watershed Assessment. On file at the Sylamore Ranger District Office, Mountain View, AR.

USDA Forest Service. 2007. Ozark-St. Francis Nationl Forests Herbicide Monitoring Plan.

USDA Forest Service. 2008. Livingston Creek Watershed Assessment. On file at the Sylamore Ranger District Office, Mountain View, AR.

USDA Forest Service. Southern Region. 2008. *Scenery Treatment Guide- Southern REgional National Forests.* Atlanta: U.S. Forest Service Southern Region.

USDA Forest Service, Forest Health Unit. Petty, Saul. 2009a. Sylamore RD Hazardous Fuels Reduction: Insect and Disease Considerations, White Paper prepared for the 2009 Ice Storm Hazardous Fuels Reduction Project, Sylamore Ranger District.

USDA Forest Service. 2009b. Climate Change Considerations in Project Level NEPA Analysis. Washington, D.C.

USDA Forest Service. 2005-2011. Southern forest inventory and analysis: Southern Research Station field guide. USDA Forest Service, Southern Research Station, Asheville, N.C.

USDA Forest Service 2011a. SERA TR 052-22-03b and SERA TR-052-22-03a-App. Forest Health Protection. Glyphosate: Human Health and Ecological Risk Assessment Final Report and Appendices. Syracuse Environmental Research Associates. www.fs.fed.us/foresthealth/pesticide/risk.shtml

USDA Forest Service. 2011b. SERA TR 052-29-03a. Forest Health Protection. Imazapyr: Human Health and Ecological Risk Assessment Final Report. Syracuse Environmental Research Associates. www.fs.fed.us/foresthealth/pesticide/risk.shtml

USDA Forest Service 2011c. SERA TR 052-25-03a and SERA TR-052-25-03a-App. Forest Health Protection. Triclopyr: Human Health and Ecological Risk Assessment Final Report and Appendices. Syracuse Environmental Research Associates. www.fs.fed.us/foresthealth/pesticide/risk.shtml

USDA Forest Service. 2012a. Carromero, William. Indiana Bat Habitat Restoration Project/Non-native invasive plants report. Project planning record.

USDA Forest Service. 2012b. Duzan, Steve. Report on Migratory Birds. Project planning record.

USDA Forest Service. 2012c. Duzan, Steve. Report on Rare Communities. Project planning record.

USDA Forest Service. 2012d. Marshall, Lauren. Indiana Bat Habitat Restoration Project. Scenery, Recreation and Wild and Scenic Rivers Report. Project planning record.

USDA Forest Service. 2012e. Meriwether, David. TACCIMO Literature Report. Generated Thursday, October 25, 2012. Project Planning Record.

USDA Forest Service. 2012f. Monk, Richard. Hydrology and Water Quality Report. Indiana Bat Habitat Restoration Project. Project planning record.

USDA Forest Service. 2012g. Osborne, Scott. Fire/Fuels Technical Report, Indiana Bat Habitat Restoration Project. Project planning record.

USDA Forest Service. 2012h. Rudolph, D. Craig. Potential Impacts of Habitat Restoration for Indiana Bats on Nocturnal Insects. Project planning record.

USDA Forest Service. 2012i. Walrod, Amanda. Roads Analysis Report / Indiana Bat Habitat Restoration Project. 95 pages. Project planning record.

USDA Forest Service 2012j. Weeks, Len. Soil Specialist Report for the Indiana Bat Habitat Restoration Project/Sylamore Ranger District. Project planning record.

USDA Forest Service. 2012k. Whalen, James K., Aquatic Communities Report / Indiana Bat Habitat Restoration Project. Project planning record.

USDA Forest Service National Forest System Data Recording Protocols and Requirements for Invasive Species Survey, Inventory, and Treatment. 2012l. 52 pp.

USDA Forest Service. Payments made under SRS PL 106-393. http://www.fs.fed.us/srs/Title 1.shtml

USDA Forest Service 2013a. Logan, Judith. Air Quality Report for Prescribed Burning Options / Indiana Bat Habitat Restoration Project, Sylamore Ranger District. Project planning record.

USDA Forest Service. 2013b. Spence, E.; Vickers, G.; Spetich M. Major Forest Communities within the Indiana Bat Habitat Restoration Project Area. Project planning record.

USDA Forest Service. 2013c. Wakefield Jessica. Biological Evaluation for the Indiana Bat Habitat Restoration Project. Project planning record.

USDA Forest Service. 2013d. Wakefield, Jessica. Regional Forester's (R8) Sensitive Listed Species Assessment for the Indiana Bat Habitat Restoration Project. Project planning record.

USDA Forest Service. 2013e. Management Plan for the Clifty Canyon Special Interest Area. Approved April 11, 2013.

USDA Forest Service. 2013f. Management Plan for the City Rock Bluff Special Interest Area. Approved April 11, 2013.

USDA Forest Service. 2013g. Management Plan for the Sandstone Hollow Special Interest Area.

USDA FSH 2409.17 – Silvicultural Practices Handbook Chapter 8 – Silvicultural Examinations, Prescriptions, and Evaluations

US NRCS 1994, State Soil Geographic Data Base data use information, USDA NRCS NSSC Misc. pub. Number 1492.

US NRCS, 2005. U.S. Natural Resources Conservation Service (NRCS), Vector Data titled - BASINS 12 DIGIT HYDROLOGIC UNIT 2006, accessed online @ http://www.geostor.arkansas.gov

USDA Soil Conservation Service. 1989. Summary report 1987 national resources inventory. Statistical bulletin number 790. Iowa State University Statistical Laboratory, 36 p.

USEPA, 2003, Level III Ecoregions of the Continental United States, map, revision of Omernik, 1987.

USEPA. http://www.epa.gov/oaqps001/greenbk/ancl.html

US Environmental Protection Agency. 2013a. Global Greenhouse Gas Emissions Data. http://www.epa.gov/climatechange/ghgemissions/global.html#three (Accessed April 11, 2013)

US Environmental Protection Agency. 2013b. Land Use, Land Use Change and Forestry. In Draft Inventory of U.S. Greenhouse Gas Emissions and Sinks: 1990-2011. http://www.epa.gov/climatechange/Downloads/ghgemissions/US-GHG-Inventory-2011-Chapter-7-LULUCF.pdf (Accessed April 11, 2013)

US Environmental Protection Agency, Aerometric Information Retrieval System Data, US Nonattainment Designations For Nitrogen Dioxide as of March 30, 2012; http://www.epa.gov/airquality/greenbook/nmcs.html

US Environmental Protection Agency, Aerometric Information Retrieval System Data, US Nonattainment Designations For Sulfur Dioxide as of March 30, 2012; http://www.epa.gov/airquality/greenbook/sindex.html

US Environmental Protection Agency, Aerometric Information Retrieval System Data, US Nonattainment Designations For Particulate Matter PM-10 as of March 30, 2012; http://www.epa.gov/airquality/greenbook/pindex.html

US Environmental Protection Agency, Aerometric Information Retrieval System Data, US Nonattainment Designations For Particulate Matter PM-2.5 as of March 30, 2012; http://www.epa.gov/airquality/greenbook/rindex.html

US Environmental Protection Agency, Aerometric Information Retrieval System Data, US Nonattainment Designations For Lead as of March 30, 2012; http://www.epa.gov/airquality/greenbook/mindex.html

US Environmental Protection Agency, Aerometric Information Retrieval System Data, Air Pollution Maps, Ready To View Maps, (Accessed 4/2/2012); http://www.epa.gov/airdata/ad_maps.html.

US Environmental Protection Agency, Aerometric Information Retrieval System Data, US Nonattainment Designations For 8-hr Ozone non-attainment as of March 30, 2012 http://www.epa.gov/airquality/greenbook/

US Environmental Protection Agency, Aerometric Information Retrieval System Data, US Nonattainment Designations For Carbon Monoxide as of March 30, 2012; http://www.epa.gov/airquality

US DOI USFWS. 1983. Recovery Plan for the Indiana Bat. Rockville, Md.

USDOI USFWS. 2007. Indiana Bat (*Myotis sodalis*) Draft RecoveryPlan: First Revision. U.S. Fish and Wildlife Service, Fort Snelling, MN. 258 pp.

USDOI USFWS. 2009. Indiana Bat (Myotis sodalis) 5-year Review Summary and Evaluation, September 2009

USDOI USFWS. 2011. A National Plan for Assisting States, Federal Agencies, and Tribes in Managing White-Nose Syndrom in Bats at www.fws.gov/WhiteNoseSyndrome/

USDOI USFWS. 2012. News Release. North American Bat Death Toll Reaches 5.5 million from White-nose Syndrome. January 17, 2012. www.fws.gov

USDOI. Payments in Lieu of Taxes. http://www.nbc.gov/pilt/pilt/search.cfm

US DOI USFWS. 2010. Report to Congress on the Recovery of Threatened and Endangered Species Fiscal Years 2009-2010.

USGS 2000. National Hydrography Dataset (NHD) and U.S. Environmental Protection Agency, 2000; Web Page: http://nhd.usgs.gov/chapter1 , accessed 03/08/2005

USGS 2012. Draft Central Hardwoods Joint Venture Glades Assessment for the Interior Highlands and Interior Low Plateaus of the Central Hardwoods Region. 3 October 2012.

V

Van Dyke 1999 cited in **Bragg, Don C., Michael G. Shelton, and Boris Zeide. 2003.** Impacts and management implications of ice storms on forests in the southern United States. Forest Ecology and Management 186 (2003) 99-123.

Van Lear, D.H., Douglass, J.E., Cox, S.K., Asburger, M.K., 1985. Sediment and Nutrient Export in Runoff Following Burned and Harvested Pine Watersheds in South Carolina Piedmont, Journal of Environmental Quality 14(2): 169-174.

Van Lear, D. H. 2002. Upland oak ecology and management. In proceedings of the Upland oak ecology symposium: history, current conditions and sustainability. Spetich, Martin., ed. 2004. Gen Tech Rep SRS-73, 311p.

Viele, D.P., A. Kurta, and J. Kath. 2002. Timing of nightly emergence. Pp. 199-207 *in* A. Kurta and J. Kennedy (eds.), The Indiana bat: biology and management of an endangered species. Bat Conservation International, Austin, TX.

Vitousek, P.M. 1990. Biological Invasions and Ecosystem Processes: Toward an Integration of Population Biology and Ecosystem Studies. Oikos 57: 7-13.

Vose, James M.: Laseter, Stephanie H.; Sun, Ge; McNulty, Steve G. 2005. Stream Nitrogen Responses to Fire in the Southeastern U.S. Third International Nitrogen Conference (N2004): Impacts of Population Growth and Economic Development on the Nitrogen Cycle: Consequences and Mitigation at Local, Regional and Global Scales. Nanjing, China.

W

Waldrop, T.A., D.H. Van Lear, F.T. Lloyd, and W.R. Harms. Long-term studies of prescribed burning in loblolly pine forests of the southeastern coastal plain. U.S.D. A. Forest Service S.E. Forest Experiment Station Gen. Tech. Rep. SE-45. 1987. 32p.

Waldrop, Thomas A.; Goodrick, Scott l. 2012. Introduction to prescribed fires in Southern ecosystems. Science Update SRS-054. Asheville, NC: U.S. Department of Agriculture Forest Service, Southern Research Station. 80 p.

Wang, G. Geoff; David H. Van Lear, and William L. Bauerle. 2005. Effects of prescribed fires on first-year establishment of white oak (Quercus alba L.) seedlings in the Upper Piedmont of South Carolina, USA. Forest Ecology and Management 213 (2005) 328-337.

Wargo, P.M.; Houston, D.R.; LaMadeleine, L.A. 1983. Oak Decline. Forest Insect & Disease Leaflet 165. Washington, DC: United States Department of Agriculture, Forest Service. 8p.

Waters, T. F. 1995. Sediment in streams: sources, biological effects, and control. American Fisheries Society Monograph 7.

Wear, David N.; Greis, John G., eds. 2002. Southern forest resourceassessment. Gen. Tech. Rep. SRS-53. Asheville, NC: U.S. Departmentof Agriculture, Forest Service, Southern Research Station. 635 p.

Weeks, L., 1993-1995 Soil disturbance monitoring on the Ozark-St. Francis National Forests. Unpublished paper. USDA Forest Service. Russellville, AR.

Weeks, L., 2007 Soil disturbance monitoring on the Ozark-St. Francis National Forests 1996-2007. Monitoring Data. USDA Forest Service. Russellville, AR.

Westbrooks, R. G. 1998. Invasive Plants: Changing the Landscape of America. Federal Interagency Committee for the Management of Noxious and Exotic Weeds. pp. 1-9, 57-59, 65-66. Washington, D. C.

Williams, R.E.; Shaw, C.G. III.; Wargo, P.M.; Sites, W.H. 1986. Armillaria root disease. Forest Insect & Disease Leaflet 78. Washington, DC: United States Department of Agriculture, Forest Service. 8p.

Wuebbles, D. J., and K. Hayhoe, 2004: Climate Change Projections for the United States Midwest, Mitigation and Adaptation Strategies for Global Change, 9, 335-363.

Wuebbles, D., Hayhoe, K., & Cherkauer, K. (2009). Chapter 8: Climate change and the upper Mississippi River basin. In: Criss, R. E. and Kusky, T. M. (Eds.), Finding the Balance between Floods, Flood Protection, and River Navigation. Saint Louis, MO: U.S. Saint Louis University, Center for Environmental Sciences, 47-54.

Y

Yates, M.D.; R.M. Muzika. 2006. Effect of Forest Structure and Fragmentation on Site Occupancy of Bat Species in Missouri Ozark Forests. Journal of Wildlife Management, 70(5): 1238-1248. 2006

Z

Zollner, Douglas. 2012. Draft Rapid Ecological Assessment of Glades on the Eastern Portion of the Sylamore Ranger District. The Nature Conservancy. 26 October 2012.

ERRATA

Indiana Bat Habitat Restoration Project
Environmental Assessment
Ozark-St. Francis National Forests
Sylamore Ranger District

July 2013

Based on the comments received during the formal 30 Day comment period for the *Indiana Bat Habitat Restoration Project* Environmental Assessment, the Responsible Official came to the conclusion that, due to the minor nature of changes between the Draft and Final Environmental Assessments, an errata sheet containing these minor changes would be issued. This errata sheet, along with the Draft Environmental Assessment becomes the Final Environmental Assessment.

This errata sheet documents minor changes between the Draft and Final Environmental Assessment for the Indiana Bat Habitat Restoration Project. Changes or additions are denoted in italics.

Table of Contents:	Biological Environments,Non-native Invasive Plant Communities, replace Communities with *Species*
	Restructure so that **Appendices** now follow List of Figures
	List of Figures, Figure 7: …sce58nic to *scenic*
Page 1:	Introduction, first paragraph, National Forest Service land to National Forest *System* land
	Introduction, last paragraph under "What are we proposing?" Italicize *Ramsey Knob, Rorie and Sugarloaf*
Page 2:	First full paragraph, o3ccur to *occur*
	First full paragraph, add "*The National Forest System acres within the project area boundary are the only acres on which management is proposed*. **No activities** …"
	Last paragraph, These include, but are not limited to, standards to*:*
Page 3:	Desired Conditions, first paragraph, "… (USFWS 1983) and are consistent (add *with*) conditions…"
Page 5:	Summary (Purpose and need for action), The purpose of this proposal is therefore to*:*
	Summary (Purpose and need for action), second bullet under "More specifically, there is a need to:" "reduce and maintain canopy closure across (add *National Forest System lands within*) primary and secondary conservation zones, and"
Page 8:	Last bullet under "Mail and Website", Organizations, other agencies, and individuals who have (delete *expressed interest in* and replace with *asked to be notified when*) projects involving these types of actions (add *are proposed*) on the Sylamore Ranger District.
Page 9:	First paragraph under Responses to Scoping (Issues): "These included effects (delete *of*) on soil, water, air, climate, vegetation, federally listed and Regional Forester's (add *R8*) sensitive (add *listed*) species…"

Page 10:	Third paragraph, "For this project, (delete *limits*, add *implementation thresholds*)*... "*...and… "Annual implementation (delete *caps*, add *thresholds*)…"
	Fifth paragraph, "…regarding canopy closure for *the* Indiana bat…"
Page 12:	Table 1, Salvage Harvests, "…wind, ice or fire, *to* remove…"
Page 17:	Table 2, Canopy Closure, last column, "If canopy closure exceeds desired levels outlined in FW47 and FW48: a. Return and thin (delete *again*) add *with a non-commercial treatment to the desired level. b. Return (*delete *burn/thin again)* add to the same area using a prescribed burn to thin the area to the desired level.
Page 18:	Table 2, Stream contamination with herbicides, last column, "…b)…at (delete *or near*)
Page 22:	Table 3, Periodic Reporting of Monitoring Results, last 2 columns, "…fiscal year, (delete *herbicide monitoring results*, add *results of monitoring for herbicide in streams*…" and "Every 3 to 5 years report results of canopy closure monitoring, add *regeneration monitoring and non-native invasive plant treatment monitoring*"
Pge 23:	Under 'Reduce or Eliminate the Use of Prescribed Fire:', second paragraph, "…could result in (delete *a violation* and replace with *temporarily exceeding* " and "that suggests (delete *violations* and replace with *temporarily exceeding*…*"* and *"*...or other *air* quality problems *(*delete *that) are*…*"*
Page 24:	First bullet, "….with herbicide *(implementation thresholds)*;
Page 25:	Fifth paragraph, last sentence, "…of implementing the proposed actions *will be*."
Page 28:	First paragraph, delete "*As required by 36 CFR 219.35*,"
	Second paragraph, last sentence, Supervisor's
Page 29:	Bulleted list, add *Recovery Plan for the Indiana Bat (1983)*
Page 32:	Last paragraph, second sentence, "The District is not aware of plans (add *by private land owners*) to convert any of (delete *the* and add *their existing*) forested private land to a non-forested use…" and last sentence, "…existing forested uses (add *on private property)*…"
Page 33:	Last paragraph, "…the annual implementation (delete *limits* and replace with *thresholds*)…"
Page 36:	First paragraph, "…no (add *new*) activities will be implemented.
Page 40:	First paragraph, second sentence, "…Forest*s* further..."

Page 51:	Paragraph following bulleted list, last sentence, "…non-native invasive *plant* species…"
Page 61:	Last paragraph, second sentence, "…at levels (delete *of*) that…"
Page 69:	Second full paragraph, second sentence, "…crowned trees. [delete *)*.]
Page 72:	Second and third full sentences, "…with vigorously growing trees (add period (*.)* and add *Therefore,*)risk of widespread…the spread (add *of*) secondary impacts…"
Page 74:	Third bullet, "…non-native invasive (add *plant*) infestations…"
Page 75:	First full sentence at the top of the page, "…beneficial because it would result (add *in*) a temporary…"
Page 81:	First paragraph under 'Canebrakes', "…National Forest*s* than…"