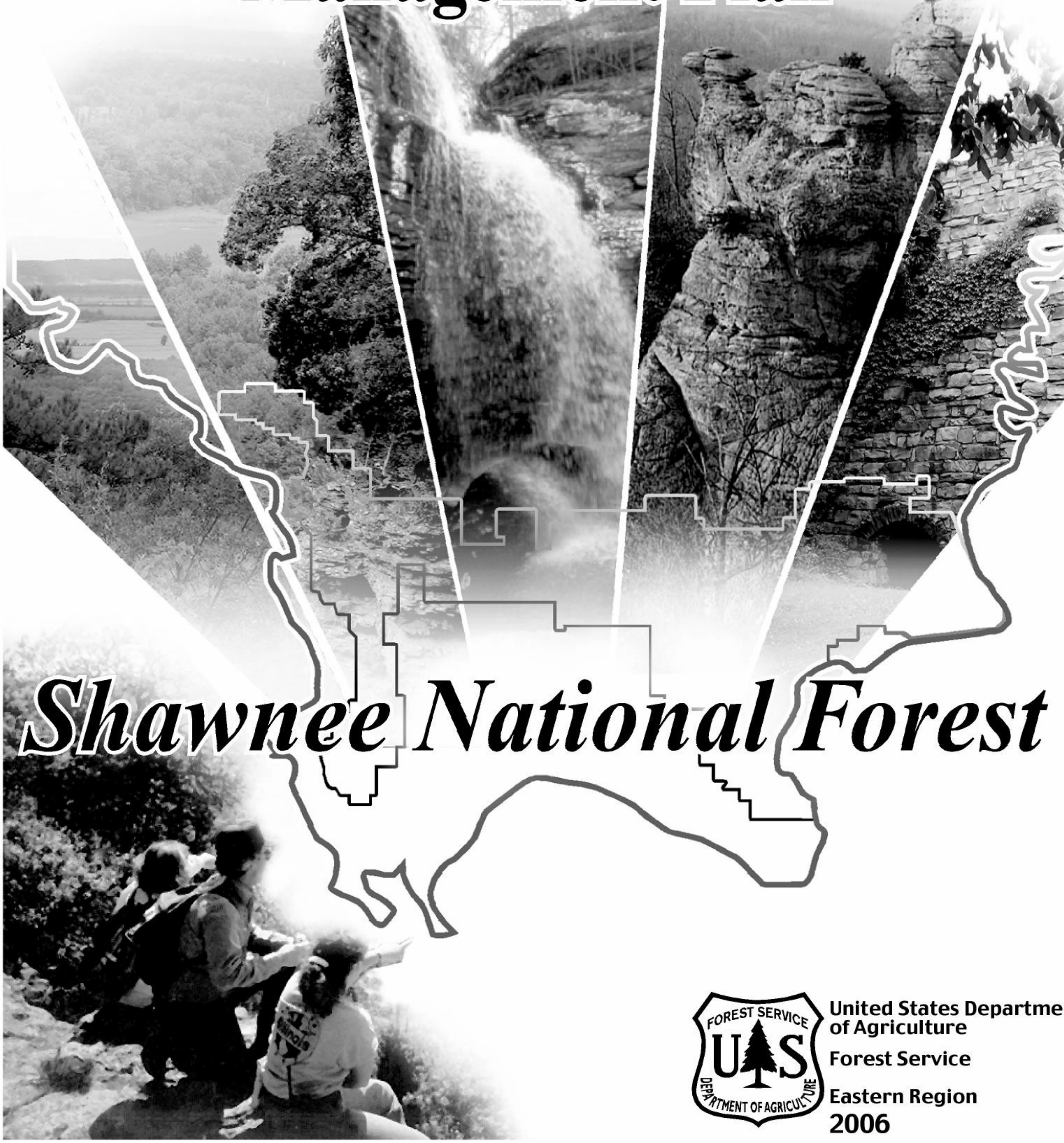
Final Environmental Impact Statement for the Land and Resource Management Plan



Shawnee National Forest

United States Department of Agriculture
Forest Service
Eastern Region
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Shawnee National Forest
Final Environmental Impact Statement
Land and Resource Management Plan

Alexander, Gallatin, Hardin, Jackson, Johnson, Massac, Pope, Saline, Union and Williamson Counties, Illinois

Lead Agency	USDA Forest Service
Responsible Official	Randy Moore, Eastern Regional Forester 626 East Wisconsin Avenue Milwaukee, WI 53202
For Information, Contact	Stephen Hupe 50 Highway 145 South Harrisburg, IL 62946 (618) 253-7114 or (800) MY WOODS

Abstract

This final environmental impact statement (FEIS) documents the analysis of four alternatives, each offering a different programmatic framework within which to manage the 285,000 acres administered by the Shawnee National Forest. The selected alternative was the basis for the revised Forest Plan that will guide all natural resource management on the Forest. The Forest Service developed the alternatives with advice from the public and other federal and state agencies. The Regional Forester explains in the Record of Decision his rationale for selecting one of the alternatives.

Alternative 1 would continue to use the management direction of the 1992 Amended Forest Plan, with uneven-aged forest management and group-selection harvest, minimally restricted equestrian use and proposed ATV/OHM trail corridors. Alternative 2, the selected alternative, emphasizes maintenance or enhancement of biodiversity on the Forest, with even-aged forest management to restore and maintain oak-hickory forest-type, prescribed fire and other vegetation management, restriction to trails of equestrian use and continuation of the closure of the Forest to ATV/OHM use. Alternative 3 emphasizes custodial management of the Forest, with no forest management, minimal prescribed fire, restricted equestrian use and no ATV/OHM use. Emphasis of Alternative 4 is similar to Alternative 1, with more equestrian and ATV/OHM use possible, and to Alternative 2, with even-aged forest management to restore and maintain oak-hickory forest-type, prescribed fire and other vegetation management.

LOCATION OF THE SHAWNEE NATIONAL FOREST

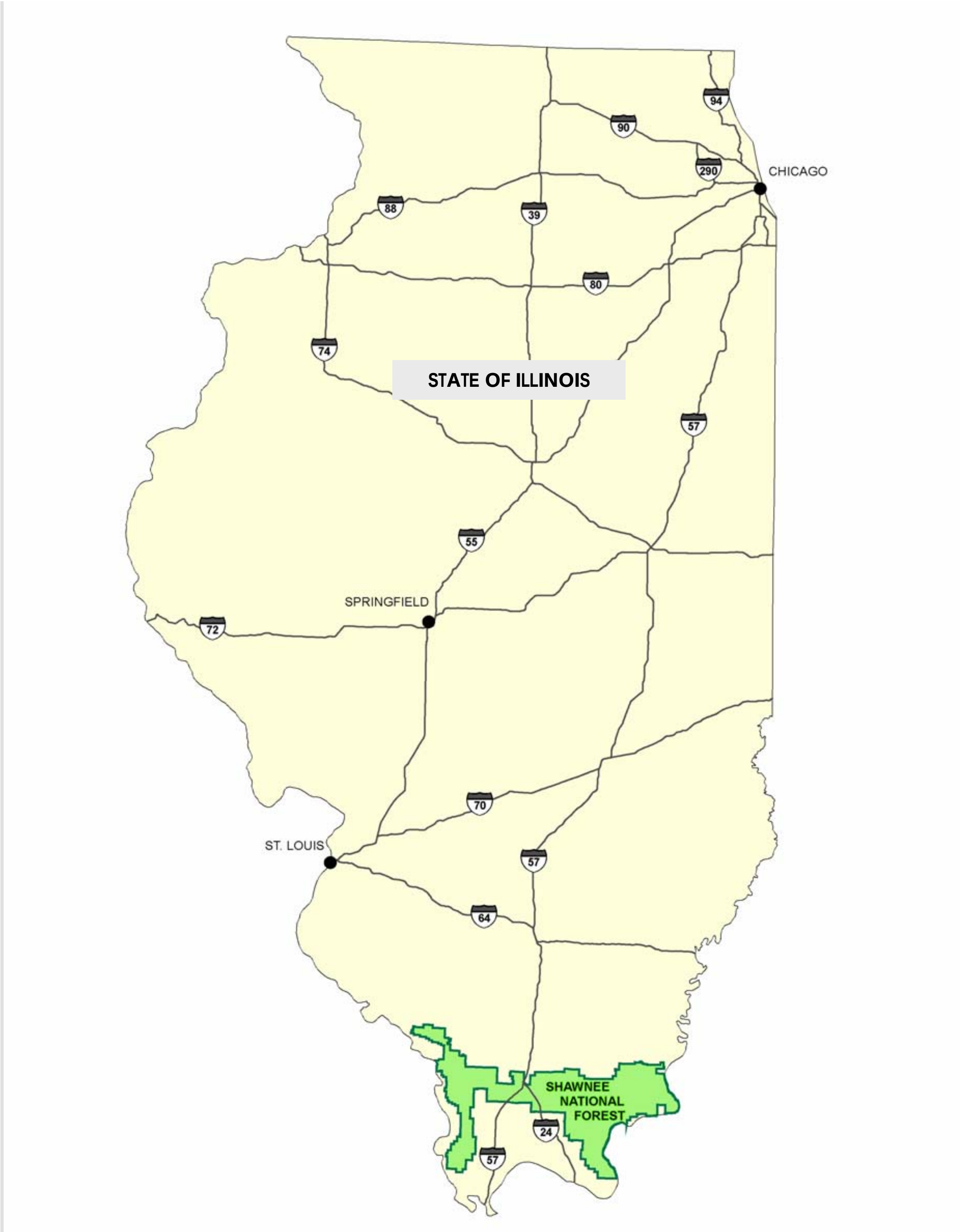


TABLE OF CONTENTS

LIST OF TABLES

LIST OF FIGURES

CHAPTER 1. PURPOSE OF AND NEED FOR ACTION

I. DOCUMENT STRUCTURE

The Shawnee National Forest (SNF/Forest) has prepared this final environmental impact statement (FEIS) in compliance with the National Environmental Policy Act (NEPA) and other applicable laws and regulations. This FEIS discloses the direct, indirect and cumulative environmental effects expected to result from the proposed, programmatic action and alternatives. The document is organized as indicated:

Chapter 1. Purpose of and Need for Action: This chapter includes information on the history of the project proposal, the purpose of and need for the project and the agency's proposal for achieving that purpose and need. This section also details how the Forest Service informed the public of the proposal and how the public responded.

Chapter 2. Alternatives, including the Proposed Action: This chapter provides a more detailed description of the agency's proposed action as well as alternative methods for achieving the stated purpose. These alternatives were developed based on significant issues raised by the public and other agencies. This discussion also includes mitigation measures. Finally, this section provides a summary table of the environmental consequences associated with each alternative.

Chapter 3. Affected Environment and Environmental Consequences: This chapter describes the environmental effects of implementing the proposed action and other alternatives. This analysis is organized by the resources that might be affected.

Chapter 4. Consultation and Coordination: This chapter provides a list of preparers and agencies consulted during the development of the FEIS.

Appendices: The appendices provide more detailed information to support the analyses presented in the FEIS.

Index: The index provides page numbers by document topic.

II. BACKGROUND

The first National Forest Management Act (NFMA) Land and Resource Management Plan (Forest Plan) for the SNF was approved by the Eastern Regional Forester on November 24, 1986. As agreed in a 1988 administrative appeal settlement, the Forest undertook further planning, which resulted in a significant amendment of the 1986 Plan.

The amendment of the 1986 Plan was approved on May 14, 1992, administratively appealed, and then challenged in federal district court by persons not party to the 1988 appeal settlement. The district court rejected some of the plaintiffs' claims, but upheld several others and vacated the 1992 amendment. In 1996, the district court issued injunctive relief that precluded commercial hardwood-timber harvest, all-terrain vehicle and off-highway vehicle trail designation and oil and gas development pending further environmental analysis.

Now, in accordance with applicable federal law, the Forest Service is proposing a revised planning framework to guide management of the Forest for the next 10 to 15 years. NFMA requires that Forest Plans be revised at least every 15 years (16 USC Sec. 1604[f][5]). The Plan revision was developed under the 1982 planning regulations at 36 CFR 219, but will be implemented under the 2005 planning regulations.

III. PURPOSE OF AND NEED FOR ACTION

The purpose of the proposed action is to revise the Plan that guides all natural resource management on Forest. This action is needed for several reasons:

- To comply with federal law requiring Plan revision every 10 to 15 years.
- To address compliance with currently applicable laws, regulations and policies and new and changing information about the Forest and its uses.
- To correct deficiencies found by the court in the environmental analysis of the 1992 amended Plan.

The Plan-revision process focuses on elements of the current Plan that require change. Identification of these elements was based on consultation with the public; analysis of new issues and information, especially the results of monitoring and evaluation; changes in law, regulations or policy; and the goals and objectives of the US Department of Agriculture (USDA) Forest Service Strategic Plan. The identified elements comprised the seven topics for revision announced in a notice of intent published in the *Federal Register* on March 20, 2002. These seven revision topics address more than 30 specific items identified as needs for change:

- Watershed Resources
- Biological Diversity, Wildlife and Aquatic Habitat
- Recreation Management
- Forest Ecosystem Health and Sustainability
- Mineral Resources
- Wilderness, Roadless Areas, Wild and Scenic Rivers
- Land Ownership Adjustment

The USDA Forest Service Strategic Plan for fiscal years 2004 to 2008 provides purpose and context for managing national forests. This Plan revision responds to the goals and objectives outlined in the Strategic Plan.

IV. PROPOSED ACTION

The proposed action is the revision of the 1992 Forest Plan to address new information and changed conditions, as described in the preceding section. Current management direction not requiring revision will be affirmed by the revised Plan. In conjunction with applicable federal law and Forest Service policies, the revised Plan sets forth a framework of goals, objectives, standards and guidelines to guide future decision-making in a multiple-use context for the next 10 to 15 years.

V. DECISION FRAMEWORK

Given the purpose and need, the Eastern Regional Forester—the Responsible Official—will review the proposed action, the other alternatives and the environmental consequences in order to decide on the preferred course of management.

The Forest Service has identified five criteria to use in the decision process for Forest Plan revision: The revised Plan must (1) improve and protect watershed conditions, (2) restore and maintain ecological sustainability, (3) increase the amount of forest restored to, or maintained in, a healthy condition, (4) provide opportunities for diverse, high-quality recreation, (5) improve the capability of the forest to provide desired sustainable levels of uses, values, products and services.

The revised Plan is a programmatic framework that guides site-specific actions, but does not authorize, fund, or implement any project-level decision. The revised Plan functions as a gateway to compliance with environmental laws during subsequent site-specific decision-making. Similar to a zoning ordinance, the revised Plan allows for activities that may occur through future decision-making, but does not itself authorize or mandate any ground-disturbing actions. Selection of the Plan is a broad-scale decision that does not compel or contain any site-specific decisions resulting in the irretrievable or irreversible commitment of resources. It simply represents one level in a multi-stage, decision-making process.

Selecting the best course of action for the Forest necessarily involves trade-offs among resources. The Plan may be amended at any time (operating similar to a zoning variance) to Salter the direction applicable on a particular site. The environmental information disclosed in this FEIS is commensurate with the programmatic nature of the proposal. For additional information on the nature of Plans, see www.fs.fed.us/emc/nfma/includes/overview.pdf.

The focus of the revised Plan is the condition of the land as a basis for providing the public with multiple-use goods and services. The Plan embodies a multiple-use concept of natural resource management. The Forest has strived to balance competing uses across the Forest landscape. Not each use can or should occur on every acre of the Forest. The vision of the revised Plan is to blend multiple-use resource management in such a way that it sustains and protects the overall health and condition of the land and best meets the needs of the American people. All this must be accomplished in a manner that maximizes long-term net public benefits in an environmentally sound manner.

Net public benefits are all the outputs and positive effects (benefits) provided by the Forest less all associated inputs and negative effects (costs). Some benefits and costs can be measured; others are more subjective and can only be described in terms of the quality of the forest environment or the public uses provided.

The Forest has many resources for which there are competing demands. These include outdoor recreation, wood, water, wildlife, wilderness, minerals and scenery. Four alternatives for revising the Forest Plan have been considered in detail in this FEIS, including continued management under the 1992 Plan. The Forest Service must decide which alternative for managing the SNF will provide the maximum net public benefits from these resources in an environmentally sound manner. In making this decision, the goods, services and beneficial environmental effects derived from implementation of the revised Plan must be weighed against the dollars required and any adverse environmental effects that may result. This is the nature of the decision to be made.

Following Plan approval, any project proposed to implement the Plan will undergo site-specific, environmental analysis prior to any ground-disturbing activity. Public involvement is a key part of project development. Site-specific actions must be consistent with the Plan standards and guidelines, which operate as parameters within which future projects must be developed.

By regulation, the contents of a Forest Plan include:

- Forest-wide multiple-use goals and objectives (36 CFR 219.11[b]);
- Forest-wide management requirements for protecting resources (standards and guidelines) (36 CFR 219.13 to 219.27);
- Management areas and management-area direction (management-area prescriptions) (36 CFR 219.11);
- Identification of lands suitable for timber production and determination of the allowable sale quantity (36 CFR 219.16);
- Monitoring and evaluation requirements (36 CFR 219.11[d]);
- Recommendations to Congress, such as for wilderness study (36 CFR 219.17).

As soon as practicable after approval of the revised Plan, the Forest Supervisor will ensure that all existing projects, outstanding and future permits, contracts, cooperative agreements and other instruments for the occupancy and use of affected lands, subject to valid existing rights, are consistent with the Plan.

Monitoring and evaluation are important parts of the planning framework. The monitoring strategy includes implementation, effectiveness and validation monitoring. The multi-staged process of Plan approval, project decision-making, monitoring, evaluation, Plan amendment and revision allows a Forest Plan to be responsive to changing social and environmental conditions. The revised Plan is a management guide that describes the Regional Forester’s expectations for future conditions. The revised Plan should not be viewed as the “final word” on management of the Forest, but rather as a vital document that can be amended and, ultimately, again revised as the need for further change arises.

VI. PUBLIC INVOLVEMENT

The Forest conducted preliminary scoping of the public, Forest Service employees and other agencies to assist in the identification of elements of the 1992 Forest Plan that required change. A notice of intent to prepare an EIS for the revision of the Forest Plan was published in the *Federal Register* on March 20, 2002. The notice described the proposed federal action and the "need for change" of the 1992 Plan, requested comments and gave some background information on the reason for the proposal and the process to be used.

Through the *Federal Register* notice, notice in the Forest's newspaper of record, *The Southern Illinoisan*, and various other means, the public was requested to submit their comments and concerns about the proposed action. The Forest received more than 2,700 responses to the notice of intent. The issues that were raised in these comments, together with those identified by the Forest Service, confirmed the need to revise the Forest Plan and helped in assessing the future management goals of the Forest. Several public meetings were held to receive comments and, later, as part of the development of alternatives to the proposed action. A summary of the public involvement effort is presented in Appendix A.

With consideration of the comments from the public, Forest Service employees and other agencies, the interdisciplinary team for the preparation of the EIS identified the issues to address in the plan-revision process.

VII. ISSUES

The Forest Service separated the issues into two groups: significant and non-significant. Significant issues are those directly or indirectly caused by implementing the proposed action. Non-significant issues are 1) outside the scope of the proposed action, 2) already decided by law, regulation, or other higher-level decision, 3) irrelevant to the decision to be made, or 4) conjectural and not supported by scientific or factual evidence. The Council on Environmental Quality's NEPA regulations explains this delineation in section 1501.7: "...Identify and eliminate from detailed study the issues which are not significant or which have been covered by prior environmental review..." A list of non-significant issues and the reasons for their categorization as non-significant is presented in Appendix A.

The significant issues were grouped into seven revision topics, listed below and addressed through the proposed revision of the Forest Plan and the alternatives to the proposal.

A. WATERSHED RESOURCES

The Forest Service is committed to protecting water quality. Indeed, watershed protection was one of the primary reasons for establishment of the National Forest System. Lands adjacent to streams and rivers are rich in biological diversity and especially important for recreation and wildlife. The Unified Federal Policy and members of the public have identified watershed maintenance and restoration as an agency priority for future management on National Forest System lands. Opportunities for improving watershed conditions over what was prescribed in the 1992 Forest Plan include new management direction for water-supply watersheds and the Mississippi and Ohio Rivers floodplains and revision of Forest-wide filter-strip guidelines.

Most agree that riparian (stream corridor) areas have special values; but there is disagreement about the width of a filter strip necessary to protect water quality and the need to restrict various uses in these areas. There is concern that unnecessary restrictions within riparian areas and filter strips will limit recreation opportunities. The effects of management and use practices on water quality will be the basis of evaluating how this issue is addressed by the alternatives and/or mitigation measures.

B. BIOLOGICAL DIVERSITY, WILDLIFE AND AQUATIC HABITAT

Almost every aspect of Forest management has some effect on biological diversity and wildlife habitat. If the Forest Service were to take no actions to manage the forest or if no one visited the Forest, the forest would continue to change over time through natural processes. The Forest Service can maintain and sustain the oak-hickory forest-type for those who follow by actively managing forest vegetation; by using, prescribing or suppressing fire; and by maintaining forest openings for certain wildlife species. Diversity and wildlife habitat can be affected differently by allowing natural processes to take their course.

There is disagreement concerning the degree of management and use activity appropriate on the Forest. Some think that there should be little or no active vegetation management, that timber harvesting will always hurt the forest and that “allowing nature to take its course” without interference is the best way to provide old-growth hardwood forests. They feel that human activity in the forest will decrease the overall biological diversity of the forest and its surrounding environment.

Others believe that the forest can be managed to provide some benefits for everyone, as well as to sustain or enhance biological diversity. These believe that this can be accomplished through appropriate vegetation-management practices and restoration of prairies, barrens, savannas and forests; that it is best to maintain the present oak-hickory forest-type and provide a mix of vegetation-conditions and habitats suitable for a wide diversity of game and non-game wildlife; that biological diversity would be enhanced best through active vegetation management, including prescribed fire and timber harvesting to maintain the oak-hickory forest-type and openlands for wildlife habitat; and through aggressive control of invasive species.

Opportunities for enhancing biological diversity—and wildlife and aquatic habitat—include improvements in management direction for forest-interior habitat and large openlands and wildlife openings and in guidance for the protection and management of threatened, endangered and sensitive species, management-indicator species and natural areas. The effects of management and use practices on biological diversity and wildlife and aquatic habitat will be the basis of evaluating how this issue is addressed by the alternatives or mitigation measures.

C. RECREATION MANAGEMENT

There are few locations in Illinois that can match the natural beauty of the Forest. While the landscape of most of the state features seemingly endless miles of cropland, the Forest offers a setting of hills, bluffs, rock-outcrops, streams and trees. This setting attracts many thousands of people each year. They come to the Forest seeking many types of recreation. Some spend their entire visit at a campground. Some seek the solitude and challenge of wilderness. Others hike, hunt, fish, ride horses or ATVs, or drive through the forest to view the scenery.

While everyone wants the Forest to continue to be a pleasant place to visit, some also want it to be available for as many types of recreational uses as possible. Most agree that a trip to the Forest is more enjoyable when they find well-maintained trails, roads, campgrounds and picnic areas. However, there are others who want only natural, unaltered environments for their recreation. Many are concerned that activities such as timber harvest or oil and gas development might destroy the natural beauty of the Forest.

Horseback-riding on the Forest has expanded greatly in the last ten years and there is disagreement over how to prevent resource damage caused by equestrian use and whether or how to regulate where and when equestrian use should be allowed. One thing about which everyone agrees is the need for a well-marked, mapped and maintained trail system. But there is disagreement as to the appropriate number of miles of trails and where they should be constructed. There is also disagreement as to whether equestrian use should be restricted to designated system trails, or whether it should continue to be allowed cross-country as under the 1992 Plan.

There is disagreement as to whether the use of ATVs and OHMs should be allowed. Some believe that the use of ATVs/OHMs has no more effect on the land than equestrian use and should be allowed anywhere horses can go. Others believe that ATV/OHM-riding has caused problems in the past, but can be an important recreational use if carefully managed. Still others see ATV/OHM-riding as totally incompatible with environmental protection and other recreational uses.

Opportunities for improving the 1992 Plan include determining the appropriate direction for developed and dispersed recreation, including equestrian, ATV/OHM and bicycle use on the Forest. The effects of management and use practices on recreational opportunities and experiences will be the basis of evaluating how this issue is addressed by the alternatives or mitigation measures.

D. FOREST ECOSYSTEM HEALTH AND SUSTAINABILITY

The Forest is one of the only public-land entities in southern Illinois providing large contiguous blocks of diverse forest and grasslands that can be managed on a sustainable basis, providing for native plant communities and habitat for native game and non-game fish and wildlife. The Forest also includes the largest blocks of oak-hickory forest in Illinois. Much of the oak-hickory forest of southern Illinois is slowly converting to a maple-beech forest because of aggressive fire-suppression for more than 50 years and reduced natural and human-induced disturbance in the last 15 years. These changes typically are accompanied by a loss of plant and animal diversity.

Many are concerned about the conversion of the oak-hickory forest to the maple-beech type because of possible adverse effects on flora and fauna. Others are not convinced that conversion to the maple-beech type will have any adverse effects on biodiversity.

There is disagreement about whether trees should be harvested from the Forest. Some believe that timber harvesting, in conjunction with prescribed fire and other vegetation-management activities, can help maintain the conditions necessary for sustaining the oak-hickory forest. Some encourage the maintenance of a balanced age-class distribution with timber harvesting, while others believe forest composition and age-classes should be based on pre-settlement conditions and the natural range of variability. Among those who believe that the Forest should be managed to maintain the oak-hickory type, differences exist over how the trees should be harvested: some support uneven-aged management and group-selection harvesting as prescribed in the 1992 Plan; others feel that shelterwood-harvest under the even-aged management system is better to create the conditions necessary for regenerating oaks and hickories.

Some want all timber harvest stopped, along with any associated road building. They do not approve of any commercial timber harvesting on National Forest System lands. They are concerned about below-cost timber sales and the effects of timber harvest on wildlife, water quality, visual quality and recreation.

Opportunities for improving forest health include a Forest goal emphasizing forest health and sustainability instead of timber production and determination of the most appropriate silvicultural practices for regenerating and maintaining the oak-hickory forest type. Oak-hickory composition-objectives based on ecological land-types and the natural range of variability, along with prioritization of non-native pine-removal based on historic oak-hickory sites, are opportunities for improving forest health. Range-management opportunities are limited on the Forest and are best suited to the research purposes of the Dixon Springs Agricultural Center.

The effects of management and use practices on forest ecosystem health and sustainability will be the basis of evaluating how this issue is addressed by the alternatives or mitigation measures.

E. MINERAL RESOURCES

Beneath the Forest lie deposits of mineral resources owned by the federal government, corporations and private citizens. These minerals can be used by industry and provide income to the federal and county governments. But mineral production usually requires some change in the forest: roads, mineshafts, drill rigs, tanks, pipelines, pumps, or open pits may be needed to develop the resource.

Some do not think that any form of oil and gas development is an appropriate use of the Forest; they are concerned about its effects on the Forest environment. The opportunity is presented by the Plan revision to evaluate the possible effects of oil spills, as stipulated by the court ruling on the 1992 Plan and other issues associated with oil/gas activities.

The effects of minerals management on forest resources will be the basis of evaluating how this issue is addressed by the alternatives or mitigation measures.

F. WILDERNESS, ROADLESS, WILD AND SCENIC RIVERS

The Illinois Wilderness Act of 1990 designated seven areas on the Forest as wilderness. It also designated two special-management areas that were incorporated into adjoining wilderness areas in 1998, following a legislated one-time opportunity for minerals development. These wilderness areas encompass 28,233 acres—about 10 percent—of the Forest.

During the Plan-revision process, the Forest considered recommending the Ripple Hollow, Camp Hutchins and Burke Branch areas for wilderness study. (The Ripple Hollow area was recommended for wilderness study in the 1992 Plan.) Although the Forest Service can only recommend wilderness study, it is not unlikely that congress would designate the areas as wilderness based solely on a wilderness-study recommendation. If the three areas were designated wilderness by congress, they would be closed to motorized use, timber harvest and development of the federal mineral estate; this to provide excellent opportunities for hunting, trapping, fishing, hiking and horseback-riding.

There is disagreement regarding the benefits of wilderness and the need for additional wilderness on the Forest. Many would like additional wilderness and many others want no more areas designated as wilderness. The most significant issues concerning the future of Camp Hutchins, Burke Branch and Ripple Hollow are related to concerns about motorized use, effective and efficient trail maintenance and mineral exploration. These issues could be addressed effectively through protective management prescriptions.

Opportunities were explored for the identification of additional roadless areas and candidate wild and scenic rivers, along with the potential classification of existing candidate wild and scenic rivers.

The effects of management and use practices on wilderness—existing and potential—and candidate wild and scenic rivers will be the basis of evaluating how this issue is addressed by the alternatives or mitigation measures.

G. LAND-OWNERSHIP ADJUSTMENT

The Forest is the largest tract of public land in Illinois and is considered an important resource by its citizens as well as the people of nearby states. These forested lands in the agricultural heartland of the nation preserve and enhance the biodiversity and health of scarce ecosystems and provide important recreational opportunities.

The Forest is comprised of fragmented federal ownership within the Forest proclamation boundary. A consolidated Forest land-base would provide for better public use and efficient management. Existing land-ownership and adjustment guidelines occasionally inhibit acquisition of land that could provide public benefits, such as areas of the Mississippi River floodplain.

Opportunities for improving land-adjustment guidelines in the 1992 Plan include new direction revising the prioritization list for surface ownership, a recommendation for statutory boundary-adjustment, elimination of the Forest consolidation map and emphasis on the acquisition of all available property rights in each land-adjustment case.

The effects of land-ownership adjustment on the various resources will be used to evaluate how this issue is addressed by the alternatives.

CHAPTER 2. ALTERNATIVES CONSIDERED

I. INTRODUCTION

This chapter describes and compares the alternatives considered for the Forest Plan revision. Maps depicting the management areas associated with each alternative are provided at the back of this document. The alternatives are presented in a graphic, comparative form, defining the differences among them and providing the decision-maker a clear basis for choice. Some of the information used to compare the alternatives is based upon the design of the alternative and some is based upon the environmental, social and economic effects of implementing each alternative.

II. ALTERNATIVES CONSIDERED IN DETAIL

The Forest Service developed four alternatives—including no action and the proposed action—in response to issues raised during scoping and at collaborative public meetings on alternatives-development.

A. ALTERNATIVE 1 – NO ACTION

Implementation of the 1992 Plan

Adoption of Alternative 1 would continue management under the 1992 Plan. There would be some minor changes, such as stipulating in the Plan the protection of listed threatened, endangered and sensitive species while removing the outdated species lists; updating the standards and guidelines for protection of threatened, endangered and sensitive species; and adopting a more focused list of management-indicator species. The Plan would also be revised to eliminate the "Special Management Areas" (5.2), both of which have been included in their adjacent wilderness areas during the life of the 1992 Plan. The overall focus of the Plan would be unchanged. This alternative provides a mix of products and uses, avoids sensitive areas, and continues use at about the same levels as provided in the past.

Recreation management includes a trail corridor map with up to 338 miles of hiker-equestrian trails, and 286 miles of ATV-hiker-equestrian trails. Cross-country equestrian riding is allowed and bicycle use is allowed on open roads and ATV trails.

Most hardwood timber would be harvested with uneven-aged management practices. Areas managed for timber production would usually be harvested in small groups up to about 1/2 acre in size. The land-base classified as suitable for timber production is approximately 115,800 acres of upland hardwood forest and the amount of timber scheduled for harvest is 1,665 thousand cubic feet in the first decade. There is no scheduled timber harvest in the Forest Interior Management Units, Cave Valley, Camp Hutchins, Burke Branch or Ripple Hollow. In addition, there would be no scheduled timber harvest in areas near lakes, streams, recreation areas, or other places identified as especially sensitive and popular for Forest users.

Under Alternative 1, pine and pin oak are not part of the suitable timber base and would not be scheduled as part of the regular timber program. However, pine timber could be made available for harvest as a by-product of work to restore natural ecosystems (by removing the non-native pine). Some pin-oak timber could also be made available as a by-product of wildlife habitat management at the Oakwood Bottoms Greentree Reservoir.

Provisions for mineral development and oil and gas leasing are allowed, with special stipulations applicable in certain management areas.

B. ALTERNATIVE 2 – SELECTED ALTERNATIVE

Alternative 2 responds to public concerns about Forest management that identified elements of the 1992 Plan requiring revision. It is based, for the most part, on the "Need for Change" document that resulted in the notice of intent to revise the 1992 Plan, scoping comments received regarding the notice of intent and public meetings convened to assist the planning team in the development of Plan-revision alternatives.

Alternative 2 offers additional emphasis and revised guidance on watershed protection; biological diversity; management of recreation resources; forest health and sustainability; minerals management; wilderness, roadless areas and candidate wild and scenic rivers; and land-ownership adjustment.

Under Alternative 2, management for watershed resources is emphasized through the identification of water-supply watersheds—Kinkaid Lake, Cedar Lake and Lake of Egypt—and specifications for their management, management direction for the Mississippi and Ohio Rivers floodplains and revised riparian filter-strip guidelines.

Biological diversity and wildlife and aquatic habitat would be enhanced through new standards and guidelines for the management of forest-interior habitat. Species that require large openland-habitat would benefit from the creation of a large-openland management prescription, while the number of small wildlife openings would be reduced to a more manageable quantity than that specified under Alternative 1. Standards and guidelines for the management and protection of threatened, endangered and sensitive species and species of concern would be revised, as under all alternatives. Natural areas would be protected.

Proposed changes in standards and guidelines pertaining to pesticide use would support the control of invasive species, further protecting and enhancing biological diversity. The opportunity for wetland and bottomland hardwood management at Oakwood Bottoms Greentree Reservoir would be expanded through adjustment of the management-area boundary to include recently acquired adjacent land. As under all alternatives, the list of management-indicator species would be focused on five species of birds that represent openland and forest habitats; species of recreational interest would no longer be listed. Collection of plants would continue to be regulated through Forest Supervisor order or existing regulations.

Alternative 2 would restrict horseback-riding to designated system trails and allow the seasonal closure of equestrian trails not constructed for all-season use. It would emphasize the development of a mapped, marked and well-maintained trail system and would direct the closure and rehabilitation of user-developed trails not designated into the trail system. The trail-corridor map from the 1992 Plan would be withdrawn and trail-density standards and guidelines would be eliminated from all management areas. The use of ATVs and OHMs would be prohibited. Licensed-vehicle use would be allowed on open roads. Bicycles would be allowed on open roads and on system trails designated for bicycle use. Additional developed recreational sites would be allowed.

Forest ecosystem health and sustainability would be a goal under Alternative 2, rather than the production of timber products. Maintenance of the oak-hickory forest-type within its natural range of variability is considered important for biological diversity and wildlife habitat. As a means of maintaining the oak-hickory forest-type, shelterwood harvest under even-aged management would be the probable silvicultural method. A variety of techniques for site-preparation, reforestation and timber-stand improvement would be allowed. Increased prescribed fire on a variety of scales would be an important tool under this alternative for maintaining the oak-hickory forest-type and other vegetative communities.

The ecological restoration of non-native pine plantations to native hardwoods would be prioritized on historically oak-hickory sites. The management prescription for Iron Mountain would be changed from Heritage Resource Significant Site to Mature Hardwood Forest to facilitate additional vegetation management while still protecting the heritage resources under Forest-wide standards and guidelines. Since there are no suitable range-allotments that do not conflict with wildlife-habitat objectives, the range-management objective would be eliminated except for research purposes.

Federal minerals outside wilderness areas are identified as available for oil and gas leasing, subject to applicable lease terms and special stipulations, including no surface-occupancy. There are no other changes in minerals-management direction.

Alternative 2 addresses the management of wilderness and areas that were considered for wilderness-study recommendation but failed to meet the basic requirements for roadless designation. Of these areas, Camp Hutchins and (the former Wilderness Study Area) Ripple Hollow would be managed under the non-motorized recreation management prescription and Burke Branch would continue to be managed under the mature hardwood forest management prescription. The standards and guidelines for wilderness management would be revised to eliminate trail densities and to allow non-native materials for trail-signing and maintenance. Group-size limits would be allowed in wilderness.

This alternative identifies the potential classification of the six streams eligible for study as part of the national wild and scenic river system and revises the candidate wild and scenic river management prescription to reflect the results of the potential classification.

Alternative 2 makes some changes regarding land-ownership adjustment. The priority list for land-ownership adjustment would be revised and the consolidation map removed. A statutory adjustment of the proclamation boundary would be recommended in order to include areas within the Mississippi River floodplain. The standards and guidelines regarding acquisition of property rights would be changed to emphasize the acquisition of all available rights, while scenic and conservation easements would be acceptable when management objectives are met.

C. ALTERNATIVE 3

Alternative 3 responds to issues raised by those who think that prescribed fire, timber harvesting, pesticide use, wildlife openings, ATV and OHM use and oil and gas leasing are all, collectively and individually, detrimental to the environment and limits human-caused disturbance of the Forest and the land. Alternative 3 emphasizes management for the preservation of mature and old-growth forest across the landscape, non-motorized recreation, additional restrictions on equestrian use and additional habitat for forest-interior wildlife and plants. To avoid the environmental effects of timber sales and to address the below-cost timber-sale issue, no land is classified as suitable for timber production. Watershed-resource proposals are the same as those under Alternative 2.

Under Alternative 3, there would be no large-openlands or wildlife-openings management and no pesticide use. There would be no cutting of trees for any reason except for human health and safety, personal-use firewood, natural area management outside of wilderness, or administrative needs (i.e. road maintenance, special use permits, etc). There would be no new road construction and no ATV or OHM access or travelways. Equestrian use of natural areas would be prohibited. Trail-density standards would be eliminated from all management areas except wilderness and densities would be calculated for each area.

Prescribed fire would be used infrequently and on small projects to maintain rare ecosystems and threatened, endangered and sensitive species. Federal minerals would be unavailable for oil/gas leasing. Invasive species would be controlled only through manual, mechanical or limited biological methods, such as grazing. The lists of threatened, endangered and sensitive species and other species of concern would be revised or removed, as under all alternatives. The activities enjoined by the court ruling on the 1992 Plan are not implemented under this alternative.

D. ALTERNATIVE 4

Alternative 4 responds to issues raised by those who would like to see more recreational opportunities than are offered under the other alternatives. Many of these people support the implementation of certain aspects of Alternatives 1 and 2 and are opposed to many of the provisions of Alternative 3. Alternative 4 emphasizes motorized and non-motorized recreation, habitat for both game and non-game wildlife and forest management to maintain the oak-hickory forest-type.

Under Alternative 4, wildlife openings and openlands are managed the same as under the 1992 Plan. Shelterwood-harvesting with reserves and prescribed fire would be used to favor large, mast-producing trees with open understories and to help maintain the oak-hickory forest-type. Watershed resource proposals are the same as under Alternatives 2 and 3. Federal minerals would be available for oil/gas leasing with a no surface-occupancy lease stipulation.

Trail management under Alternative 4 is similar to the 1992 Plan; however, it emphasizes a well-marked, mapped and maintained trail system and removes the trail corridor map. Additional trails would be allowed in natural areas and equestrian and bicycle use would be allowed on designated trails in natural areas. Alternative 4 retains the up-to 286 miles of ATV trail-corridor from the 1992 Plan and allows additional ATV and OHM opportunities on up to 50 percent of the maintenance level 1 and 2 roads and allows licensed-vehicle use on open roads. Trail-density standards are removed from all management areas.

No new wilderness recommendations are made and the management prescription for Ripple Hollow is changed to mature hardwood forest. Candidate wild and scenic rivers are managed as provided under Alternative 2. Mineral management would be the same as under Alternative 2, with no surface occupancy. Federal minerals would be available for oil/gas leasing subject to a no surface-occupancy lease stipulation.

E. MITIGATION COMMON TO ALL ALTERNATIVES

During project-level implementation of the revised Plan, compliance with Plan standards and guidelines provides a basic level of protection for all resources and mitigates adverse environmental effects. General mitigation measures developed by the Forest Service are incorporated into management prescriptions and are summarized here by resource area. Site-specific mitigation measures will be specified, as necessary, during the environmental analysis of proposed projects.

1. SOIL

Many management and use activities have the potential to affect soil through disturbance; some require the use of heavy equipment. Road, skid-trail, fire-line, drill-site and log-landing construction and mechanical site preparation exposes mineral soil, decreases infiltration rates and increases erosion potential. This is mitigated in two ways. Standards and guidelines restrict the type of activities and degree and duration of soil disturbance to the inherent capacity of the soil involved. They also control the location and extent of soil exposure, require ripping, harrowing or other de-compaction procedures and/or require re-vegetation as soon as is practicable (see Forest Plan Appendix F).

2. WATER QUALITY

Soil exposed during management activities to rain and melting snow can be carried by runoff to streams and lakes. Standards and guidelines for reclaiming disturbed sites and for managing filter-strips along perennial and intermittent streams and around lakes prevent most sediment from reaching waterways and riparian areas.

3. RECREATION

Developed sites are generally avoided by other management activities (special circumstances would require special mitigation). Dispersed recreation may suffer somewhat when timber harvest, road construction or minerals development is taking place. However, these activities would occur only on a very small fraction of the Forest at any one time. Standards and guidelines ensure that trails will be protected during or restored after these management activities.

4. CULTURAL RESOURCES

Surface-disturbing activities generally can have an adverse effect on any cultural resources present at the disturbed location. Standards and guidelines require site identification, assessment and protection or mitigation prior to any surface disturbance. Surface disturbance is generally not permitted in areas set aside for management under the HR prescription.

5. VISUAL QUALITY

Standards and guidelines set visual-quality objectives for all management areas. Changes made in the visual character of a viewshed are mitigated in several ways; e.g., varying the size and shape of openings to match the surroundings, use of color to soften contrasts, debris-disposal requirements and retention of "leave areas" of trees to break up open ground. Finally, nearly half of the Forest is under management in which few changes to the visual character are likely to occur.

6. VEGETATION DIVERSITY

Unique or rare plant communities have been inventoried and mapped and are managed under the NA prescription for their protection.

7. FISH AND WILDLIFE

The needs of forest-dwelling species are addressed in the various management areas on the Forest. E.g., managed openings and harvest regeneration provide for yellow-breasted chat, northern bobwhite, turkey and deer. Forest interior management, corridors for candidate wild and scenic rivers and wilderness provide for species (e.g. scarlet tanager, wood thrush and cerulean warbler) requiring contiguous blocks of closed-canopy forest. In addition, standards and guidelines provide or protect specific habitats: snag/den-tree clumps and stream-crossing limits and shading requirements, for instance.

8. THREATENED, ENDANGERED, SENSITIVE SPECIES

Standards and guidelines require review of all surface-disturbing projects by qualified professionals prior to implementation to determine whether any threatened, endangered or sensitive species or habitat will be affected by the project. Consultation with USFWS is mandatory if the species or habitat may be affected.

9. WILDERNESS CHARACTER

The Illinois Wilderness Act of 1990 protects over 28,000 acres of the Forest. In addition, standards and guidelines for wilderness management ensure the protection of wilderness character.

III. ALTERNATIVES CONSIDERED BUT ELIMINATED FROM DETAILED STUDY

Federal agencies are required by NEPA to rigorously explore and objectively evaluate all reasonable alternatives and to briefly discuss the reasons for eliminating any alternatives that were not developed in detail (40 CFR 1502.14). Comments received from the public since the publication of the notice of intent and during the public alternatives-development meetings provided suggestions for alternative methods of achieving the purpose and need. Some of these suggested alternatives were outside the scope of the Plan-revision process or were determined by the planning team to have components that would cause unnecessary environmental harm. Therefore, some alternatives were considered but dismissed from detailed consideration for the reasons summarized below.

Several suggestions, such as eliminating natural areas and proposed wild and scenic river study corridors as management areas, expanding the list of management indicator species and species of recreational interest, allowing only single-tree selection harvest, eliminating prescribed fire, allowing equestrian trails in all natural areas, converting all user-developed trails to Forest system trails, prohibiting all equestrian use, not expanding the Oakwood Bottoms Greentree Reservoir, and terminating the tenancy of the University of Illinois at Dixon Springs Agricultural Center, are all specific items that were not carried forward into alternatives because they did not meet the purpose and need for the Plan revision. The following alternatives were considered but not analyzed in detail.

A. WILDERNESS STUDY FOR RIPPLE HOLLOW, BURKE BRANCH, CAMP HUTCHINS

Many suggested that the Ripple Hollow, Burke Branch and Camp Hutchins areas should be recommended for designation as wildernesses. Only congress can designate wilderness areas through legislation. However, the Forest Service can recommend areas for wilderness study if they meet roadless-area criteria. These areas were evaluated, along with others on the Forest, to determine whether they met the roadless-area criteria. Other than areas that are already designated wilderness, no areas on the Forest were found to meet the criteria. Therefore, no areas on the Forest are recommended for wilderness study. Since Ripple Hollow was tentatively recommended for wilderness study in the 1992 Plan, the wilderness study management prescription is retained for this area under Alternative 1.

Ripple Hollow and Burke Branch were part of the Roadless Area Review and Evaluation II (RARE II) process of the 1970's and also included in the Roadless Area Conservation Rule of 2001. Management in these areas will continue to be governed by the direction in the Roadless Area Conservation Rule until such time when the Rule is no longer applicable.

B. USE OF ONLY PRESCRIBED FIRE TO CONTROL MAPLE-BEECH

Comment on the DEIS suggested that an alternative should be developed that considers the use of only prescribed fire to control maple-beech competition in the understory, without the use of other vegetation treatments, such as timber harvesting and timber-stand improvement activities.

The interdisciplinary team reconsidered this approach; but, in light of the need to maintain and sustain the oak-hickory forest-type and the biodiversity dependent upon it, its drawbacks were apparent. The shade-tolerant maple has become established in many places across the Forest and has grown to a size that would not be affected by prescribed fire alone. Several studies have shown that larger-diameter trees are not likely to be killed by prescribed fire alone. Franklin *et al.* (2003) found that burning did not affect stems greater than 3.8 centimeters DBH (DBH), and that thinning was generally necessary for the understory to respond to burning treatments. Rebbeck *et al.* (2004) found that red and sugar maples are susceptible to fire only when stems are small (less than 6 centimeters DBH). Elliott *et al.* (2004) found that most mortality from understory burning occurred in trees less than 10 centimeters DBH, and no trees greater than 20 centimeters DBH were killed.

The amount of sunlight reaching the forest floor is also an important factor in the regeneration of oaks. Inadequate light often limits oak regeneration and recruitment into the overstory (Lorimer, 1993). If larger trees cannot be killed by prescribed fire, other vegetation treatments would be needed to provide adequate sunlight for the growth of young oaks and hickories. Since the use of only prescribed fire in specified areas has been proposed and analyzed under Alternative 3, the team declined to analyze the approach to any greater extent.

C. NO TIMBER REMOVAL DURING NESTING SEASON OF MIGRATORY BIRDS

A comment on the DEIS suggested that, in order for the Forest Service to be in compliance with the Migratory Bird Treaty Act, an alternative should be analyzed that prohibits timber removal during the nesting season of the migratory birds.

As part of the Plan-revision process, the Forest has taken, and continues to take, many planning and administrative actions to ensure the conservation of migratory birds. This complies with Executive Order 13186, which directs all federal agencies, including the Forest Service, to work with the US Fish and Wildlife Service to conserve populations of migratory birds.

Alternative 3 allows no timber removal. The interdisciplinary team believes this adequately portrays the effects on migratory birds of no timber removal during the nesting season. Accordingly, an alternative that limits timber removal only during the nesting season was considered unnecessary.

D. BENCHMARK ALTERNATIVES

Several "benchmark" alternatives were developed during analysis for the Forest Plan revision. Benchmarks represent production potentials for various resources and uses. Benchmarks were developed for maximum timber production, maximum oak-hickory, maximum present net value of market values, and minimum level management. The National Forest Management Act, Multiple-Use Sustained-Yield Act, Endangered Species Act, and other laws and Forest Service policy require that national forests be managed for a variety of uses as well as resource protection. The benchmark alternatives were eliminated from detailed consideration because they would not provide balanced resource protection and management.

IV. COMPARISON OF ALTERNATIVES

This section provides summaries of the details of each alternative as well as the effects of implementing each alternative. Information in the tables is focused on activities and effects where different levels of effects or outputs can be distinguished quantitatively or qualitatively among alternatives.

A. MANAGEMENT PRESCRIPTIONS

A "management prescription" is a specification of management practices to be applied on the ground in a specific area and designed to attain multiple use and achieve the desired future condition of the land. Each management prescription describes the practices selected, the desired future condition of the land, and the standards and guidelines necessary to achieve that condition. A "management area" is a discrete unit (or units) of the Forest that is managed under a specific management prescription. Table 2-1 presents a summary of the acreage assigned to each management prescription under each alternative.

The spatial distribution of management areas varies by alternative. A specific management prescription may be applied to several locations on the Forest; that is, a management area may not be (and usually is not) one continuous block of land. It is also possible to have an inclusion of one management prescription within another larger management area. An example is a natural area inside the boundaries of an experimental forest, wilderness, or an area on the national register of historic places. Should a conflict arise, the more stringent management direction would take precedence. Table 2-2 presents the acreage of each management area by alternative.

Table 2-1. Management prescription details.

Management Prescription	Sign	Description	Alter-native
Camp Hutchins	**CH**	Guides the management of the Camp Hutchins area under Alternative 1 in order to maintain the ecological integrity of the area.	**1**
Candidate Wild and Scenic River	**CR**	Guides the management of a ¼-mile–wide corridor on either side of a candidate wild and scenic river in order to maintain potential classification—scenic under Alternative 1, recreational under Alternatives 2, 3 and 4.	**1, 2, 3, 4**
Cave Valley	**CV**	Guides the management of the Cave Valley area to maintain bottomland hardwood habitat.	**1, 2, 3, 4**
Developed Recreational Site	**DR**	Guides the management of developed recreational sites Forest-wide.	**1, 2, 3, 4**
Even-Aged Hardwood Forest	**EH**	Guides management of even-aged forest to maintain the oak-hickory forest-type—the only areas classified as suitable for timber production under Alternatives 2 and 4. Under Alternative 2, shelterwood would be probable harvest method; under Alternative 4, shelterwood with reserves.	**2, 4**
Forest Interior	**FI**	Guides the management of forest-interior habitats—units of at least 1,100 acres. Forest-interior habitat—units of at least one-mile diameter—is managed Forest-wide under Alternatives 2, 3 and 4.	**1**
Filter Strip and Riparian Area	**FR**	Guides the management of filter strips and riparian areas under Alternative 1. Soil and water resources are protected through Forest-wide standards and guidelines under Alternatives 2, 3 and 4.	**1**
Heritage Resource Significant Site	**HR**	Guides the management, protection and interpretation of significant heritage-resource sites. Does not apply to Iron Mountain site under Alternatives 2 and 4.	**1, 2, 3, 4**
Large Openland	**LO**	Guides the management of large openlands in order to provide habitat for wildlife requiring openlands.	**2, 4**
Mature Hardwood Forest	**MH**	Guides management of mature hardwood forest, generally near areas with high recreational use, with emphasis on wildlife habitat and recreation.	**1, 2, 3, 4**
Minimum-Level Management	**MM**	Guides the management of generally isolated parcels where the cost of access is high.	**1, 2, 3, 4**
Mississippi and Ohio Rivers Floodplains	**MO**	Guides the management of the floodplains in order to provide bottomland hardwoods and wetlands for species requiring them.	**2, 3, 4**
Natural Area	**NA**	Guides the management of natural areas to maintain biological diversity and natural communities. Designated multi-use trails are allowed under Alternatives 2 and 4.	**1, 2, 3, 4**
Non-motorized Recreational Area	**NM**	Guides the management of the Camp Hutchins and Ripple Hollow areas under Alternative 2; includes the Burke Branch area under Alternative 3.	**2, 3**
Oakwood Bottoms Greentree Reservoir	**OB**	Guides the management of the Oakwood Bottoms Greentree Reservoir to provide flooded habitat for migratory and wintering waterfowl and other wetland species.	**1, 2**
Research Area	**RA**	Guides the management of areas used for manipulative research, such as Dixon Springs Agricultural Center and Kaskaskia Experimental Forest.	**1, 2, 3**
Recommended for Wilderness Study	**RW**	Guides the management of the Ripple Hollow area (under Alternative 1).	**1**
Uneven-Aged Hardwood Forest	**UH**	Guides the management of uneven-aged forest, the only areas classified as suitable for timber production under Alternative 1.	**1**
Wilderness	**WD**	Guides the management of congressionally-designated wilderness areas in order to maintain the wilderness character and recreational experience.	**1, 2, 3**
Water-Supply Watershed	**WW**	Guides the management of community water-supply watersheds in order to maintain water quality.	**2**

Table 2-2. Management area acreage by alternative.

Management Prescription	Sign	Alternative 1	Alternative 2	Alternative 3	Alternative 4
Camp Hutchins	CH	3,700	0	0	0
Candidate Wild and Scenic River	CR	14,600	14,600	14,600	14,600
Cave Valley	CV	2,000	2,000	2,000	2,000
Developed Recreational Site	DR	1,600	1,600	1,600	1,600
Even-Aged Hardwood Forest	EH	0	137,700	0	141,400
Forest Interior Management Unit	FI	9,300	0	0	0
Filter Strip and Riparian Area	FR	5,900	0	0	0
Heritage Resource Significant Site	HR	4,300	3,300	4,200	3,300
Large Openland	LO	0	3,700	0	0
Mature Hardwood Forest	MH	37,300	24,900	160,300	31,800
Minimum-Level Management	MM	10,000	7,900	8,100	7,900
Mississippi and Ohio Rivers Floodplains	MO	0	8,700	8,700	8,700
Natural Area	NA	14,800	15,400	15,400	15,400
Non-motorized Recreation Area	NM	0	6,900	11,700	0
Oakwood Bottoms Greentree Reservoir	OB	4,700	4,700	4,700	4,700
Research Area	RA	7,700	7,700	7,700	7,700
Recommended for Wilderness Study	RW	3,700	0	0	0
Uneven-Aged Hardwood Forest	UH	136,900	0	0	0
Wilderness	WD	28,100	28,100	28,100	28,100
Water-Supply Watershed	WW	0	17,400	17,400	17,400
Total		284,600	284,600	284,600	284,600

Table 2-3. Comparative details of alternatives by issue and/or need-for-change item.

Issue/Need-for-Change Item	Alternative 1 No Action 1992 Forest Plan	Alternative 2 Selected Alternative	Alternative 3	Alternative 4
Watershed Resources				
Water-Supply Watersheds - including Kincaid Lake, Cedar Lake and Lake of Egypt	• Manages water-supply watersheds under the MH and FR MAs. • Allows trails and motorized and non-motorized use. • Allows cross-country equestrian use off system trails. • Allows vegetation management for wildlife and other objectives	• Creates WW MA emphasizing management for water-quality protection. • Requires system trails be designed to a standard protective of water quality. • Prohibits ATV/OHM use. • Allows horses and bicycles on roads and system trails designated for these uses. • Allows temporary and permanent roads for administrative use. • Emphasizes obliteration of roads causing erosion. • Allows vegetation management for wildlife or ecological reasons.	• Same as Alt. 2 except does not allow vegetation management or road construction.	• Same as Alt. 2.
Mississippi and Ohio River Floodplains	• Manage floodplains under FR.	• Creates MO MA. • Promotes pedestrian and boat access, wildlife-viewing, hunting and hiking. • Promotes facilities for foot-travel and other dispersed recreation (viewing blinds, parking, etc.) • Emphasizes wetland development, restoration and management.	• Same as Alt. 2.	• Same as Alt. 2.
Riparian Area Filter-strip Standards and Guidelines (S&Gs)	• Applies riparian and filter-strip S&Gs in FR Forest-wide (mostly unmapped). • Sets filter-strip widths at 100 feet for intermittent streams and 200 feet for perennial streams. • Width of filter-strips along lakes is 100 feet. • Width of filter-strips along wetlands is 25 feet. • Applies bare-soil exposure limits to mechanical or recreation-caused disturbances such as fire lines, roads and trails at ten percent of each 7,500	• Eliminates the FR MA and applies riparian and filter-strip S&Gs Forest-wide, but not in OB or MO. • Sets filter-strip widths for intermittent streams at 50-150 feet, perennial streams at 100-300 feet. Filter-strips vary within the range according to land-slope adjacent to the stream. • Ephemeral streams have a 25-foot filter-strip where bare soil limits apply, but remain suitable for timber resource management. • Width of filter strips for lakes is same as perennial streams. • Width of wetland filter strips is 100 feet. • Applies bare-soil exposure limits to mechanical or recreation-caused disturbances, such as fire lines, roads and	• Same as Alt 2.	• Same as Alt. 2.

Issue/Need-for-Change Item	Alternative 1 No Action 1992 Forest Plan	Alternative 2 Selected Alternative	Alternative 3	Alternative 4
	square-foot segment of filter strip.	trails at ten percent of each 7,500 square-foot segment of filter strip. (Prescribed fire is excluded from bare soil exposure limits). • Adds language to Forest-wide S&Gs for riparian areas and filter strips: "Construction and rehabilitation of roads, trails and firelines will preserve the beneficial values, protect public safety and be cost-efficient."		
Biodiversity, Wildlife & Aquatic Habitat				
Forest-Interior Habitat	• Establishes Forest Interior Management Units (FI) MA: - 1100 acres x 7. - 4 on west side - 3 on east side. • Allows vegetation management in the FIMUs only to facilitate research associated with migratory birds.	• Eliminates FI. • Applies forest-interior habitat management guidelines to the EH and MH MAs for land in federal ownership at least one mile diameter in size and without powerlines, paved roads, levees, or lakes (about 66,000 acres). • Timber harvesting (about 6,700 acres in 1st decade) may be used to improve forest-interior habitat and would occur primarily on ridgetops and upper slopes using shelterwood-with-reserves harvest method. Thinning may occur in the bottoms and on lower slopes.	• Retains FI. • Emphasis on unmanaged MH. • Maintains any areas with 500 or more contiguous forest-system acres as unmanaged forest for interior bird habitat. • Applies no wildlife or forest management in all Forest MAs.	• Eliminates FI. • Similar to Alt. 2—applies forest-interior habitat management guidelines to the EH and MH for land in federal ownership at least one mile diameter in size and without powerlines, paved roads, levees, or lakes (about 65,000 acres). • Timber harvesting (about 10,000 acres in 1st decade) may be used to improve forest-interior habitat and would occur primarily on ridgetops and upper slopes using shelterwood-with-reserves harvest method. Thinning may occur in the bottoms and on lower slopes.
Large Openland Management	• Openland S&G maintains every oldfield or grassland 80 acres or larger totaling about 2,700 acres in UH, FR, MH and CR MAs.	• Creates LO MA prescription totaling about 2,700 acres for management of tracts greater than 80 acres in size and eliminates '92 plan openland S&G. • Management objective to maintain early-successional habitats and species. • Management may include removal of small trees (e.g., eastern red cedars), invasive shrubs (e.g., autumn olive) and non-native	• Reforests openlands except barrens, glades and hill prairies.	• Same as '92 plan.

Issue/Need-for-Change Item	Alternative 1 No Action 1992 Forest Plan	Alternative 2 Selected Alternative	Alternative 3	Alternative 4
		grasses and forbs with fire, mechanical and/or chemical treatments. • Allows application of this management prescription within the WW. • Promotes dispersed recreational uses.		
Wildlife Openings	• Retains all existing wildlife openings (two percent of ownership, or approximately 1630 openings totaling about 2,500 acres).	• Allows wildlife openings. • Applies forest interior guidelines in EH and MH. • Applies '92 Plan guidelines outside of interior blocks. • Results in about 500-700 openings totaling about 700 acres (less than two percent of Forest area).	• Allows no wildlife openings	• Same as '92 Plan.
Threatened, Endangered & Sensitive Species	• Same as Alt. 2.	• Revises S&Gs for federally listed threatened and endangered species and Regional Forester sensitive species and species of concern identified in the viability analysis to contribute to viability and promote recovery. • Incorporates by reference all federally listed threatened and endangered species and Regional Forester sensitive species.	• Same as Alt. 2.	• Same as Alt. 2.
Natural Areas	• Manages natural areas to preserve, protect and enhance the unique natural values of each area. • Allows designated system trails according to 1992 Trails-Corridor Map and equestrian use on designated trails.	• Provides for identification, protection ***and*** management (prescribed fire, tree and shrub removal, etc.) of ecosystems and communities at risk of loss or degradation; and allows designation of new natural areas. • Removes '92 Plan language regarding boundary changes. • Allows bicycle and equestrian use on system trails designated for such use.	• Same as Alt. 2, except allows no equestrian use and eliminates or re-routes existing trails in Lusk Creek, Garden of the Gods and LaRue Pine Hills natural areas. • Allows prescribed fire infrequently for small projects. About 3,000 acres per year would be burned to help maintain barrens in natural areas.	• Same as '92 plan, except allows no new natural areas except for protection of federally listed threatened and endangered species. • Allows bicycle and equestrian use on system trails designated for such use. • Allows designation of additional trails in natural areas.
Non-Native Invasive Species management (plants and animals) and noxious weed control.	• Allows for control in NA and WD MAs. • No specific direction in other management prescriptions.	• S&Gs to control invasive species, following regional and national guidelines. • Allows control of invasive plants and animals to include such practices as prescribed fire, cutting of woody growth, application of approved pesticides, mowing, biological control and/or manual removal.	• Same as Alt. 2, except allows only mechanical, manual (to include burning of individual plants), or limited biological (e.g., grazing) methods of control.	• Same as Alt 2.
Management	• Same as Alt. 2.	• Reduces MIS to five bird species to represent	• Same as Alt. 2.	• Same as Alt. 2.

Issue/Need-for-Change Item	Alternative 1 No Action 1992 Forest Plan	Alternative 2 Selected Alternative	Alternative 3	Alternative 4
Indicator Species (MIS)		openland and forest interior habitats: northern bobwhite, yellow-breasted chat, scarlet tanager, wood thrush and worm-eating warbler.		
Oakwood Bottoms Greentree Reservoir Boundary Adjustment MA (OB)	• Same as Alt. 2.	• Adjusts MA boundary to include newly acquired lands. Timber harvesting not scheduled as management practice during next two decades.	• Same as Alt. 2.	• Same as Alt. 2.
Pesticide-use and biological pest controls	• Allows use of pesticides only when "essential" to meet management objectives. • Allows biological treatments as pesticide alternative.	• Amends current pesticide-use S&Gs. Allows use of pesticides and biological treatments following site-specific environmental analysis that indicates use will meet management objectives.	• Prohibits pesticide use and allows only mechanical, manual, or limited biological controls (e.g., grazing).	• Same as Alt. 2.
Species of Recreational Interest	• Retains list in '92 plan.	• Includes species of recreational interest on monitoring list.	• Same as Alt. 2.	• Same as Alt. 2.
Recreation Management				
Equestrian Use	• Allows year-round equestrian use on potential 624 miles system multi-use trails, including road connections. Use is allowed on estimated 286 miles of system roads and hundreds of miles of non-system roads. • Allows system trails in natural areas according to 1992 trails-corridor map. • Allows cross-country equestrian use on about 264,000 acres. (All MAs, except some DR, all HR, & NA).	• Allows equestrian use on potential 700 miles of system multi-use trails, including road connections. Use is allowed on estimated 386 miles system roads and hundreds of miles of non-system roads. • Allows system trails to be designated in natural areas. • Allows seasonal closure of bare-soil trails (estimated at 350 miles [50%]) from Dec–April. • Prohibits cross-country equestrian travel (affects 284,000 acres). • Closes and/or rehabilitates user-developed trails not designated into the trail system (no mileage estimate). • Allows designation of user-developed trails as system trails where appropriate.	• Allows equestrian use on 450 miles of system multi-use trails, including road connections, closed seasonally (Dec-April). Use is allowed on estimated 426 miles of system roads and hundreds of miles of non-system roads. • Allows no equestrian use in natural areas; eliminates or reroutes existing trails in Lusk Creek, Garden of the Gods and LaRue Pine Hills natural areas. • Prohibits cross-country equestrian travel (affects 284,000 acres). • Closes and/or rehabilitates user-developed trails.	• Allows year-round use on 700 miles of system multi-use trails, including road connections. Use is allowed on estimated 386 miles of system road and hundreds of miles of non-system roads. • Allows system trails to be designated in natural areas. • Prohibits cross-country equestrian travel (affects 284,000 acres). • Allows designation of user-developed trails as system trails where appropriate.

Issue/Need-for-Change Item	Alternative 1 No Action 1992 Forest Plan	Alternative 2 Selected Alternative	Alternative 3	Alternative 4
	• Allows use on existing user-developed trails (estimated at 450 miles Forest-wide).			
Designated Trails that are mapped, marked and maintained. Equestrian and hiker trail use.	• Allows cross-country equestrian use and identifies a proposed system of trails (trail-corridor map). • Allows existing user-developed trails. • Allows equestrian use in all seasons. • Includes map of 338 miles of hiker/ equestrian trails (with about 150-200 miles of dual- designated roads). • Requires closure or restriction of areas or trails to prevent or stop resource damage. • Keeps existing trail-density S&Gs for each MA.	• Restricts equestrian use to designated trails by stages and roads open to public vehicular travel and requires monitoring of the effects of this use. • Allows designation of user-developed trails as system trails where appropriate. • Allows seasonal closure of designated equestrian trails not constructed for all-season use. • Prioritizes and emphasizes development of a mapped, marked and maintained trail system. • Directs closure and rehab (as needed) of user-developed trails not designated into the trail system. • Eliminates trail-corridor map. • Eliminates trail-density S&Gs from all MAs. • Trail goal = about 600-700 miles of system trails, including dual-designated roads.	• Same as Alt. 2, except requires seasonal and weather-related trail closures to horses and bicycles (includes all trails and dirt- and grass-surface roads). • Eliminates trail-density S&Gs from all MAs except wilderness. • Trail goal = about 350-450 miles and 150-200 miles of system trails, including dual-designated roads.	• Same as '92 Plan. Plus emphasizes a marked, mapped and maintained trail system. • Allows designation of additional equestrian trails in natural areas. • Allows designation of user-developed trails as system trails where appropriate. • Drops trail-density S&Gs from all MAs. • Trail goal = about 600-700 miles of system trails, including dual-designated roads. • Eliminates trail-corridor map.
All-terrain Vehicle (ATV)/Off-highway Motorcycle (OHM)	• Identifies corridors for up to 286 miles of motorized system ATV/OHM trails and road connections. • ATV/OHM (unlicensed) use allowed on the remainder 526 mi. Forest System roads about 3 weeks/year for firearm deer-hunting season. • Restricts ATV/OHM use to designated travelways. • Results in licensed OHM's allowed on 526 miles of system roads open to public motorized use.	• ATV and unlicensed OHM use is prohibited Forest-wide, except for administrative use, access by emergency vehicles, or as authorized by permit or contract. • Licensed OHMs allowed seasonally on 458 miles of level 1 & 2 road and year-round on more than 2,800 miles of level 3, 4, 5 roads (all jurisdictions).	• ATV and unlicensed OHM use is prohibited Forest-wide except for administrative use, access by emergency vehicles, or as authorized by permit or contract. • Licensed OHMs allowed seasonally on 458 miles of level 1 & 2 roads and year-round on more than 2,800 miles of levels 3, 4, 5 roads (all jurisdictions).	• Retains up-to 286 miles of motorized system ATV/OHM trails and road connections from Alt. 1. • Allows availability of up to 50 percent (about 167 miles) of level 1 and 2 roads not in the up-to-286-mile ATV/OHM system. • Allows licensed OHM use on the remainder of level 1 and 2 roads and on all other open roads.

Issue/Need-for-Change Item	Alternative 1 No Action 1992 Forest Plan	Alternative 2 Selected Alternative	Alternative 3	Alternative 4
Licensed Off Highway Vehicles (Jeeps, 4-wheel drive trucks, etc.)	• Seasonal use allowed on about 458 miles of level 1 & 2 roads. • Use allowed on over 2,800 miles of level 3, 4, 5 road (all jurisdictions)	• Seasonal use allowed on about 458 miles of level 1 & 2 FS road. • Use allowed on over 2,800 miles of level 3, 4, 5 roads (all jurisdictions).	• Same as alt. 1	• Seasonal use allowed about 167 miles of non-ATV/OHM route, level 1 & 2 roads. • Use allowed on over 2,800 miles of level 3, 4, 5 roads (all jurisdictions).
Bicycle use	• Allows use on roads open to public motorized use and on designated ATV/OHM travelways. • Allows bicycle use on 286 miles of multi-use system trails, including road connections. Year-round use is allowed on 526 miles of system roads (estimated 100 miles of road/trail connections).	• Allows bicycle use on open roads and on system trails designated for bicycle use. • Allows bicycle use on estimated 600 miles of multi-use system trails & road connections. • Allows seasonal closure of bare-soil trails (estimated 350 mi. [50%]) from Dec. – April. • Results in seasonal use on 358 miles of FS level 1 & 2 road (est. 100 mi. road/trail connections). • Results in year-round use on 68 miles of level 3, 4, 5 roads (estimated 100 miles road/trail connections). • Monitors use.	• Allows bicycle use on open roads and on system trails designated for bicycle use. • Allows use on estimated 350 miles multi-use system trails & road connections (closed seasonally Dec.-April). • Results in seasonal use on 408 miles of level 1 & 2 roads (estimated 50 miles road connections in item #1) • Results in year-round use on 118 miles of level 3, 4, 5 roads (estimated 50 miles road/trail connections).	• Allows bicycle use on open roads and on system trails designated for bicycle use. • Allows bicycle use on estimated 600 miles of multi-use system trails and road connections. • Allows use on 286 miles ATV/OHM routes. • Results in seasonal use of 358 miles level 1 & 2 rd (estimated 100 miles road connection in above trails) • Results in year-round use of 68 miles level 3,4,5 roads (estimated 100 miles road/trail connections).
Trail Corridor Map	• Retains trail-corridor map.	• No trail-corridor map: Trail locations based on site-specific project implementation.	• Same as Alt. 2	• Same as Alt 2.
Trail Density	• Trail densities dependent on MA S&Gs.	• None	• None outside of wilderness (see wilderness).	• None
Developed and Dispersed Recreation	• Allows no new developed recreational sites.	• Allows new developed recreational sites (e.g., campgrounds, picnic grounds, boat launches) and closure of existing low-use and/or high-cost sites. • Eliminates site-density standard.	• Same as Alt. 1.	• Same as Alt 2.
Forest Health and Sustainability				
Forest Management	• Timber resource management goal. • Approximately 41 percent of total Forest landbase is suitable for timber	• Establishes a goal emphasizing forest ecosystem health and sustainability to replace 1992 timber-resource management goal. • Approximately 41 percent of the total Forest	• Allows no forest vegetation management. • Designates all UH from Alt. 1 as MH with no active vegetation management. No areas on the	• Establishes a goal emphasizing forest ecosystem health and sustainability to replace 1992 timber-resource

Issue/Need-for-Change Item	Alternative 1 No Action 1992 Forest Plan	Alternative 2 Selected Alternative	Alternative 3	Alternative 4
	resource in the UH. • Allowable sale quantity (ASQ) of 1,665 Mcf (thousand cubic feet) – pine is not suitable • Approximately 47 miles of specified road reconstruction, 29 miles of temporary road construction and 100 miles of road obliteration are scheduled in the first decade.	land-base is suitable for timber resource management in the EH. • ASQ of 7,751 Mcf for first decade. • Approximately 94 miles of road reconstruction, 59 miles of temporary road construction and 20 miles of road obliteration are scheduled in the first decade.	Forest are suitable for timber resource management. • ASQ equals 0. • Allows no road construction associated with timber resource management and road obliteration is the same as Alt. 1.	management goal. • Approximately 42 percent of the total Forest land-base is suitable for timber resource management in the EH. • ASQ of 7,357 Mcf for first decade. • Approximately 95 miles of road reconstruction, 59 miles of temporary road construction and no road obliteration.
Silvicultural Practices	• Group selection is the proposed harvest method in MA UH. • Approximately 5,700 acres/year of prescribed fire is scheduled for maintenance of natural areas, wildlife habitat and for site preparation for oak-hickory. • Uses a variety of reforestation techniques, including natural and artificial regeneration.	• Shelterwood harvest is the proposed practice for oak-hickory regeneration in MA EH and allows intermediate treatments to control stand composition. Allows uneven-aged management where needed to meet other resource objectives. • Implements prescribed fire on a variety of scales, including large landscape scale, up to 12,400 acres per year. Prescribed-burning prescriptions attempt to emulate historic disturbance regimes and condition classes (but may vary to achieve other objectives due to ownership patterns and existing vegetation). • Employs silvicultural practices such as timber harvesting, timber-stand improvement, prescribed fire, herbicide treatments, thinning and tree-planting as tools for maintaining and restoring the oak-hickory ecosystem.	• Allows no commercial or non-commercial cutting of trees other than for human health and safety reasons, personal-use firewood, natural area mgt. outside wilderness, or administrative needs (i.e. road maintenance, special use permits, etc). • Allows prescribed fire infrequently for small projects in natural areas and only after pre-burn flora and fauna surveys have been performed and analyzed for potential impacts. About 3,000 acres per year will be burned to help maintain barrens in natural areas.	• Shelterwood harvest with reserves is the proposed practice for oak-hickory regeneration in the EH MA and allows intermediate treatments to control stand composition. Allows uneven-aged management where needed to meet other resource objectives. Employs shelterwood with reserves and burning to favor open understories and large mast-producing trees. • Allows prescribed fire as in Alt. 2 and prescribes up to 12,000 acres per year. • Employs silvicultural practices such as timber harvesting, timber-stand improvement, prescribed fire, herbicide treatments, thinning and tree-planting as tools for maintaining and restoring the oak-hickory ecosystem.
Oak-Hickory	• Specifies a vegetation	• Manages for oak-hickory tied to ecological	• Contains no vegetation	• Same as Alt. 2.

Issue/Need-for-Change Item	Alternative 1 No Action 1992 Forest Plan	Alternative 2 Selected Alternative	Alternative 3	Alternative 4
Forest Management	composition objective of 25 percent oak-hickory in MAs UH and MH. • Utilizes vegetation management to protect unique values in MA NA. • Management of Fountain Bluff and Iron Mountain as HR MA limits vegetation management practices and oak-hickory regeneration.	land-types and historical disturbance regimes. S&Gs for MAs EH, MH and OB have oak-hickory composition objectives based on natural range of variability for subsections and land-type associations. • Changes management prescription for Iron Mountain from HR to MH MA to allow management practices favoring oak-hickory.	composition objectives for oak-hickory. Ecological land-type associations, subsections and historical information would not be bases for composition objectives. • Emphasis on unmanaged MA MH allows conversion to maple-beech forest-type. • Management prescription for Iron Mountain remains HR MA.	
Pine Plantation Management	• Permits removal of pine for restoring natural ecosystems (ecological restoration) except in WD MA. • Approximately 800 acres per year of pine are scheduled for restoration to hardwoods	• Emphasizes non-native pine removal on historical oak-hickory sites. • Includes previously unsuitable pine plantations in the suitable timber base. • Approximately 800 acres of pine are scheduled per year for restoration to hardwoods.	• Allows no removal of non-native pine except for human health and safety or administrative needs (i.e. road maintenance, special use permits, etc). • Allows pine die-off naturally.	• Same as Alt. 2.
Non-Native Invasive Species management (plants and animals) and noxious weed control.	• Allows for control in Natural Areas and Wilderness MAs. • No specific direction in other management prescriptions.	• S&Gs to control invasive species following regional and national guidelines. • Allows control of invasive plants and animals, to include such practices as prescribed fire, cutting of woody growth, use of pesticides, mowing, biological control, and/or manual removal.	• Same as Alt. 2, except allows only mechanical, manual (including burning of individual plants), or limited biological (e.g., grazing) methods of control.	• Same as Alt. 2.
Pesticide-use and biological pest controls	• Allows use of pesticides only when “essential” to meet management objectives. • Allows biological treatments as pesticide alternative.	• Amends current pesticide-use S&Gs. Allows use of pesticides and biological treatments following site-specific environmental analysis.	• Prohibits pesticide use and allows only mechanical, manual, or limited biological controls.	• Same as Alt. 2.
Range Management	• Allows range management in MAs UH, MH, FR, RA, MM and CR.	• Allows no range management in any MAs except for research purposes (e.g., at Dixon Springs Agricultural Center).	• Same as Alt. 2.	• Same as Alt. 2.
Minerals Management				

Issue/Need-for-Change Item	Alternative 1 No Action 1992 Forest Plan	Alternative 2 Selected Alternative	Alternative 3	Alternative 4
Oil, Gas and Mineral Leasing	• Identifies areas on the Forest suitable for oil, gas and mineral exploration and development and incorporates stipulations that identify areas as unsuitable or suitable with conditions. • Gives consent to BLM to lease federal minerals for oil/gas with appropriate lease terms and stipulations.	• Identifies areas on the Forest where the mineral estate is federally owned as available for oil/gas leasing with lease terms and stipulations. Makes no consent-to-lease decision (as in 1992 Plan). • Applies "no-surface-occupancy" stipulations to MAs for CV, DR, NA, HR and CR and filter strips and riparian areas. • Applies special stipulations to MAs OB, WW, MO, MH and NM. • Applies standard lease stipulations in MAs EH, LO, RA and MM. • Federal minerals are withdrawn under the Wilderness Act. The Forest has no authority to designate availability or unavailability within wilderness.	• Identifies the federal mineral estate as unavailable for oil/gas leasing.	• Same as Alt. 2, except applies "no-surface-occupancy" stipulations Forest-wide.
Wilderness, Roadless, Wild and Scenic Rivers				
Roadless Area Management	• Manages Ripple Hollow under RW MA.	• Makes no wilderness study recommendations. • Manages Ripple Hollow and Camp Hutchins under new NM MA. • Manages Burke Branch under the MH MA.	• Makes no wilderness study recommendations. • Manages Ripple Hollow, Camp Hutchins and Burke Branch under new NM MA.	• Makes no wilderness study recommendations. • Manages Burke Branch, Camp Hutchins and Ripple Hollow under the MH MA.
Wilderness Trail Density	• 1 mi/sq. mi – for all wilderness areas. • Results in 50 miles of system trail – no new construction without eliminating other trails	• No trail density standards. • Allows new construction. Estimated over 50 miles.	• 1 mi/sq. mile for each of 7 wilderness areas. • Eliminates half of the trails in GOG (reduces to 6.6 miles), eliminates 2/3 mi. trail in Panther Den (reduces to 1.5 miles), allows construction of 4 miles in Burden Falls and 4 miles in Bay Creek Wildernesses. About 50 miles total.	• Same as Alt 2.
Wilderness Use of Non-native Materials	• Trail-marking standards limit the use of native materials. This would require removal of carsonite, painted and wooden signs on trails and	• Allows use of non-native materials (e.g., carsonite signs and posts, paint, gravel) to provide visitor safety and resource protection.	• Allows limitations on group sizes in wilderness.	• Same as Alt. 2, with exception of group-size limitations.

Issue/Need-for-Change Item	Alternative 1 No Action 1992 Forest Plan	Alternative 2 Selected Alternative	Alternative 3	Alternative 4
	around natural areas and removal of hitching posts and highlines.			
Group Size Limits	• No provisions for group size limits.	• Allows limitations on group sizes in wilderness.	• Same as Alt. 2.	• Same as Alt. 1.
Special Management Area Prescription - East Fork - Eagle Creek	• Same as Alt. 2.	• Eliminates the Special Management Area MA because the East Fork and Eagle Creek areas have been incorporated into the Lusk Creek and Garden of the Gods Wildernesses, respectively and managed under the WD MA.	• Same as Alt. 2.	• Same as Alt. 2.
Wild and Scenic River classification	• Provides interim direction (CR) for protection of ¼-mile corridors on each side of six streams as scenic classification, because the rivers were not classified.	• MA CR management prescription to reflect results of classification: all Recreational except upper 10 miles of Lusk Creek are Scenic.	• Same as Alt. 2.	• Same as Alt. 2.
Land Adjustment				
Revise priorities for land acquisition	• Identifies priorities for acquisition by management prescription. Provides a map that identifies areas of the Forest where consolidation is a priority.	• Priority list for land adjustments are revised based on conditions/situations and not management areas. • Eliminates consolidation map because land acquisition opportunities that may occur during the management period cannot be anticipated.	• Same as Alt 2.	• Same as Alt. 2.
Recommend Proclamation Boundary adjustment	• Does not address Statutory Boundary Adjustment.	• Recommends that the Proclamation Boundary of the Forest be changed to include areas within the Mississippi River floodplain.	• Same as Alt. 2.	• Same as Alt. 2.
When acquiring land, emphasize acquisition of all available rights on land acquired	• Directs acquiring only the interest needed to achieve land management objectives, rather than all available property rights.	• Changes S&Gs to emphasize acquisition of all available property rights. Scenic and conservation easements are acceptable when management objectives are met.	• Same as Alt. 2.	• Same as Alt. 2.

B. SUMMARY OF EFFECTS OF ALTERNATIVES

This section summarizes the effects anticipated from implementation of any of the alternatives in relation to the main issues.

1. WATERSHED RESOURCES

Under Alternatives 2, 3 and 4, the creation of the Water-Supply Watershed and the Mississippi and Ohio Rivers Floodplains management-prescription areas will emphasize the protection of soil and water resources in these areas. New filter-strip guidelines based on slope of the land adjacent to streams, lakes and wetlands established under these alternatives should offer somewhat greater protection to streams and water-bodies than under Alternative 1. Alternative 3, with minimal soil-disturbing activities, would result in the least-adverse effects on soil and water resources when compared to the other alternatives. Alternative 1, with the allowance of cross-country equestrian use and user-developed trails, would have the greatest effects on soil and water resources.

2. BIODIVERSITY, WILDLIFE AND AQUATIC HABITAT

Several aspects of biological diversity were analyzed, including effects on habitats and communities, management indicator species, species with viability risks, threatened, endangered and sensitive species, forest-interior habitat and natural areas.

Regarding habitats and communities, each of the alternatives would continue to manage natural areas and the most-diverse barrens habitats on the Forest. As to forest communities, Alternatives 2 and 4 would maintain the most oak-hickory forest-type, followed by Alternative 1. Alternative 3 would maintain the least amount of the oak-hickory type; and it is projected that the Forest would eventually be dominated by the maple-beech forest-type under this alternative. Woodland communities would benefit most under Alternatives 2 and 4, with landscape-scale ecosystem burns, and least under Alternatives 1 and 3, which do not envision the landscape-scale burns.

Each alternative would have beneficial effects on cliffs, rock outcrops, caves and wetlands. Cultural communities, such as oldfields, would be maintained to the highest degree under Alternatives 1 and 4 and the least under Alternative 3, with Alternatives 2 focusing management on the maintenance of larger expanses of grasslands and oldfields. Non-native pine plantations would be converted to more-diverse native hardwoods under any alternative, but active management under Alternatives 1, 2 and 4 would improve the diversity in these plantations sooner than under Alternative 3.

Table 2-4. Summary of effects on MIS habitats and populations.

MIS	Alt. 1 Cumulative Effects	Alt. 1 Population-Trends on the Forest	Alt. 2 Cumulative Effects	Alt. 2 Population-Trends on the Forest	Alt. 3 Cumulative Effects	Alt. 3 Population-Trends on the Forest	Alt. 4 Cumulative Effects	Alt. 4 Population-Trends on the Forest
Northern bobwhite	7% increase in habitat quality and quantity	Stable-slightly increasing	13% increase in habitat quality and quantity	Stable-slightly increasing	6% decrease in habitat quality and quantity	Slight decline	13% increase in habitat quality and quantity	Stable-slightly increasing
Yellow-breasted chat	22% increase in habitat quality and quantity	Stable-slightly increasing	26% increase in habitat quality and quantity	Stable-slightly increasing	19% decrease in habitat quality and quantity	Slight decline	25% increase in habitat quality and quantity	Stable-slightly increasing
Wood thrush	8% increase in habitat quality and quantity	Stable-slightly increasing	15% increase in habitat quality and quantity	Stable-slightly increasing	2% decrease in habitat quality and quantity	Stable	15% increase in habitat quality and quantity	Stable-slightly increasing
Worm-eating warbler	No change in habitat quality and quantity	Stable	2% increase in habitat quality and quantity	Stable	2% increase in habitat quality and quantity	Stable-slightly increasing	2% increase in habitat quality and quantity	Stable
Scarlet tanager	6% increase in habitat quality and quantity	Stable	8% increase in habitat quality and quantity	Stable	No change in habitat quality and quantity	Stable-slightly increasing	8% increase in habitat quality and quantity	Stable

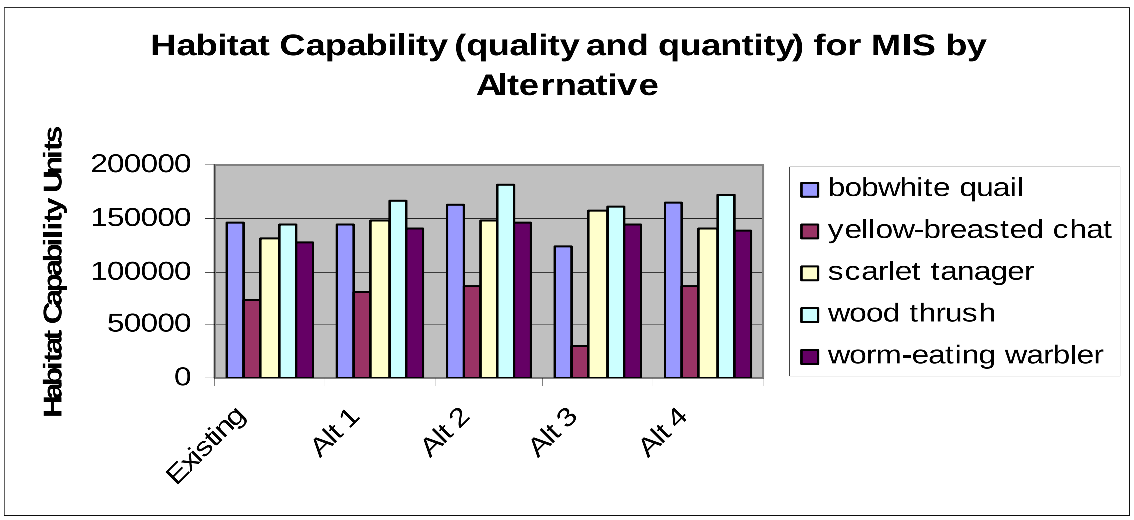
Table 2-5. Summary of effects on habitats for species with viability risk.

Species	Habitat Indicators (from Tables 2-2 and 3-37)	Alt. 1	Alt. 2	Alt. 3	Alt. 4
Red-headed woodpecker	Acres of open oak woodland – decades 2 and 10	15,000 15,000	76,200 76,200	10,000 10,000	74,900 74,900
Red-headed woodpecker	Acres of oak-hickory – dominated bottomland forests - decades 2 and 10	6,300 8,300	6,300 8,300	6,300 8,300	6,300 8,300
Red-headed woodpecker	Acres of oak-dominated upland forest - decades 2 and 10	186,700 176,400	189,900 192,400	192,400 131,400	188,000 190,300
Red-headed woodpecker	Acres of open, hardwood forests (0-60% canopy closure) – decades 2 and 10	81,100 37,500	78,000 62,200	77,700 36,200	78,900 64,900
American woodcock	Acres of early-successional (0-20 years old) hardwood forests – decades 2 and 10	16,400 7,000	18,200 13,800	21,609 5,700	16,400 14,900
American woodcock	Acres of managed grasslands, oldfields, wildlife openings – decades 2 and 10	23,500 23,500	7,400 7,400	0 0	23,500 23,500
River otter	Miles of managed perennial streams – decades 2 and 10	150	150	150	150
Spring cavefish	Managed springs and seeps	All, including 16 large springs	All, including 16 large springs	All, including 16 large springs	All, including 16 large springs
River otter	Acres of managed swamps	All existing and future (about 1,100-2,000)	Same as Alt. 1	Same as Alt. 1	Same as Alt. 1
Carolina thistle, pink milkwort, prairie parsley	Acres of managed barrens communities – decades 2 and 10	2,700 2,700	2,700 2,700	2,700 2,700	2,700 2,700
Carolina thistle	Acres of prescribed fire – decades 2 and 10	15,000 15,000	76,200 76,200	10,000 10,000	74,900 74,900
Shortleaf pine and rhodod-endron	Acres of managed LaRue-Pine Hills/Otter Pond RNA	2,811	2,811	2,811	2,811

The effects on management indicator species (MIS) habitats and populations are summarized in Table 2-4. Effects on habitat capability for MIS are displayed in Figure 2-1. Overall, Alternatives 2 and 4 would most improve the populations and habitat of the species of the four alternatives. Effects by the second and tenth decades on the habitats of species with viability risk are presented in Table 2-5. The effects of the alternatives are similar for most of the species, except those that benefit from oak-hickory and early-successional forests would not benefit to the same degree over the long term under Alternative 3. Figure 2-2 displays the total number of at-risk species—federally listed threatened and endangered, MIS and species with viability concerns—*beneficially* affected by each alternative.

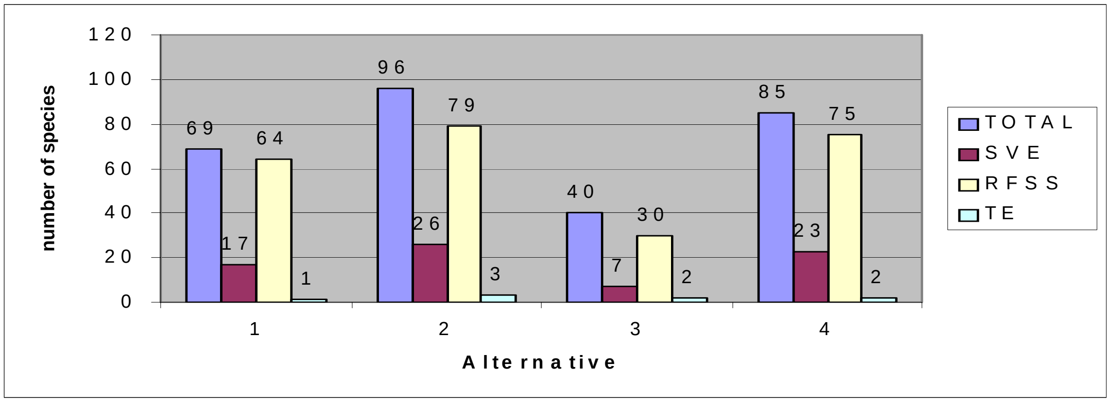
Under any alternative, standards and guidelines are revised and updated for threatened, endangered and sensitive species. Therefore, all of these species will be protected under any alternative. However, Alternatives 2 and 4 would provide more-beneficial effects for the species that benefit from greater amounts of prescribed fire, large openlands, early-successional habitat and oak-hickory forest.

Figure 2-1. Habitat capability for MIS by alternative.



As displayed in Table 2-6, Alternatives 2, 3 and 4 would provide the greatest amount of forest-interior habitat. Forest-interior blocks of about one mile in diameter and 500 acres in size are identified as the best areas on the forest for forest-interior habitat. Alternative 1 would offer only about 7,600 acres of forest-interior management units directly maintained as habitat. Alternatives 2 and 4 would actively manage, with shelterwood or shelterwood-with-reserves timber harvest and thinning, to maintain a portion of the oak-hickory forest-type in the forest-interior blocks, as well as maintain the forest-stand structure suitable for interior habitat. Alternative 3 would passively manage the entire forest, including the forest-interior blocks, for mature and old-growth forest, allowing no timber harvest.

Figure 2-2. At-risk species beneficially affected, by alternative.



Alternative 3 would not attempt to maintain the oak-hickory forest-type and, so, would have adverse effects on species that utilize the mast-producing oak-hickory forests. Table 2-7 displays the acreages of mast-producing oak-hickory forest in the short and long term.

Table 2-6. Forest-interior habitat (based on GIS analysis).

Acres	Alt. 1	Alts. 2 and 4	Alt. 3
Total directly managed for forest interior	7,600 acres (FI management area only)	56,290 acres (EH and MH management areas where interior guidelines are applied)	56,290 acres (MH management areas)
Total core areas within managed, forest-interior areas	700 acres (FI management area only)	9,388 acres (EH and MH management areas where interior guidelines are applied)	9,388 acres (MH management areas only)
Total core areas greater than 400 meters from hard edges	35,248 acres (in all management areas)	35,248 acres (in all management areas)	35,248 acres (in all management areas)
Total de facto forest-interior areas	67,700 acres (in WD, CV, CR, HR, NA, CH, RW and RA other than Dixon Springs)	43,115 acres (1/2-mile radius of areas free of hard edges) in management areas CR, CV, HR, MM, NA, NM and WD indirectly providing habitat for interior species	43,115 acres (same as Alts. 2 and 4)
Total area managed directly and indirectly to benefit forest-interior species	75,300 acres	99,400 acres	99,400 acres

Natural areas, and the unique natural communities they include, are protected under any alternative. However, since Alternatives 1, 2 and 4 allow the consideration of equestrian system trails in natural areas, it is possible that any of these three alternatives could have some adverse, direct and indirect effects on the communities. Trail use could lead to the introduction of non-native species as well as to off-trail use that could damage sensitive plants or their habitat. Alternative 3 would allow no trails in natural areas. With the exception of the natural areas with hiker trails—Garden of the Gods, Pounds Hollow, Little Grand Canyon and Bell Smith Springs—most should incur no adverse, direct or indirect effects under this alternative.

Table 2-7. Acreage of mast-producing forests in the short term and long term.

Acreages from Spectrum Model	Alt. 1	Alt. 2	Alt. 3	Alt. 4
Existing condition of oak-hickory Forests	192,800	192,800	192,800	192,800
Existing condition of mature (over 50 years) oak-hickory forests	177,800	177,800	177,800	177,800
Acreage of oak-hickory forests in the short term (20 years)	191,600	196,200	198,700	194,300
Acreage of mature (over 50 years old), mast-producing oak-hickory forests in the short term (20 years)	169,600	172,300	171,400	172,200
Acreage of oak-hickory forests in the long term (150 years)	166,772	192,776	115,808	195,045
Acreage of mature (over 50 years old), mast-producing oak-hickory forests in the long term (150 years)	147,950	123,971	110,310	126,849

3. RECREATION MANAGEMENT

The principal difference in the effects of the alternatives on recreation is related to equestrian and ATV/OHM opportunities. Alternative 1 offers the most opportunities for horseback-riding, with three-quarters of the Forest available for cross-country equestrian use. It also allows up to 286 miles of ATV/OHM trails. Alternatives 2, 3 and 4 would restrict equestrian use to system trails; however, Alternatives 2 and 4 envision up to 55 percent more miles of non-motorized trails than does Alternative 3. Additionally, Alternative 4 would allow ATV/OHM opportunities on up to 286 miles of trail and up to 167 miles of system roads closed to licensed, motorized vehicles. Bicycling opportunities are greatest under Alternative 4, but are greater under Alternatives 2 and 3 than under Alternative 1. Dispersed recreational opportunities would be similar under any alternative. Table 2-8 displays the projected use-estimates for recreation use.

Table 2-8. Estimated Forest visits for the year 2015.*

		NVUM*	Current Use Projected to 2015	Alt. 1	Alt. 2	Alt. 3	Alt. 4
Non-local use	Visits	176,657	203,156	203,156	203,156	203,156	203,156
Local use	Visits	345,748	345,748	345,748	345,748	345,748	345,748
Equestrian use	Visits	47,970	52,884	52,884	42,307	42,307	52,884
ATV/OHM use	Visits	1,755	1,952	44,501	1,952	1,952	44,501
Bicycle use	Visits	12,870	14,318	17,182	39,556	39,556	44,501
Total	Visits	585,000	618,058	663,471	675,268	619,270	690,790
% Difference from Alt. 1					+2%	-9%	+4%

*September, 2004 update of visitor-use spreadsheet created by Michigan State University based on a 2002 visitor-use survey.

4. FOREST ECOSYSTEM HEALTH AND SUSTAINABILITY

The maintenance of forest ecosystem health and sustainability is addressed in different ways under each of the four alternatives. Alternative 1 proposes the use of uneven-aged management and group selection for regeneration of the forest. Alternatives 2 and 4 propose even-aged management, shelterwood and shelterwood with reserves as probable harvest methods, in conjunction with prescribed fire and timber-stand improvement, to help regenerate and maintain the oak-hickory forest-type. Alternative 3 allows no timber harvesting and desires a future condition of mature and old-growth trees across the Forest.

Table 2-9. Projected, long-term (150 year) age-/size-class distribution of the oak-hickory and maple-beech forest-types.

Forest-Type Age-/Size-Class*	Alternative 1	Alternative 2	Alternative 3	Alternative 4
Oak-Hickory	**Acres**			
Seedlings/Saplings	4,284	13,848	1,431	13,294
Posts/Poles	14,537	54,957	4,067	54,901
Sawtimber	25,048	59,136	4,022	62,185
Old Growth	122,902	64,835	106,288	64,664
TOTAL	166,772	192,776	115,808	195,045
Maple-Beech	**Acres**			
Seedlings/Saplings	2,850	2,852	2,850	2,848
Posts/Poles	5,699	5,704	5,699	5,697
Sawtimber	8,999	8,701	8,723	8,675
Old Growth	57,832	42,858	109,371	41,676
TOTAL	75,380	60,115	126,643	58,897

***** Size-classes based on ages: seedling/saplings = 0-20 years, post/poles = 20-70 years, sawtimber =70-120 years, and old growth = 120+ years.

One of the main issues associated with forest ecosystem health and sustainability is the maintenance of the oak-hickory forest-type on sites that historically have supported oak-hickory forests, and the succession of shade-tolerant maple and beech trees on many of these sites. Table 2-9 presents the projected, long-term (150 year) effects of management on the amount of oak-hickory and maple-beech forest-types under the four alternatives. Figure 2-3 graphically compares the effects of the alternatives over time on the forest-types and openlands.

Timber harvesting is proposed under three alternatives as part of the vegetation-management program for maintenance of the oak-hickory forest-type and for conversion of non-native pine plantations to native hardwoods. Harvesting is proposed on lands considered suitable for timber management and, on lands considered unsuitable, for other purposes, such as natural-community management or habitat enhancement. Proposed timber harvesting and probable harvest methods are displayed in Table 2-10.

Figure 2-3. Effects of alternatives on forest-types and openlands.

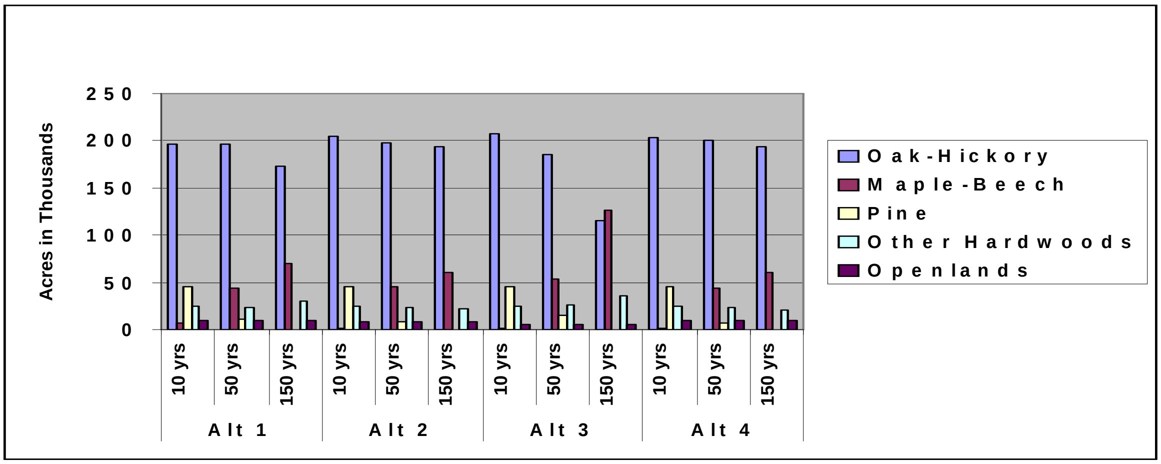


Table 2-10. Proposed and probable timber-harvest methods by forest-type during the first decade, on suited and unsuited lands (in acres).

Alternative and Forest-Type	Group Selection		Shelterwood		Shelterwood with Reserves		Thinning	
	Suited	Un-Suited	Suited	Un-Suited	Suited	Un-Suited	Suited	Un-Suited
Alt. 1								
Hardwood	2,770	0	0	0	0	0	0	0
Pine	0	0	0	0	0	4,380	0	0
Alt. 2								
Hardwood	0	0	3,197	659	1,500	400	263	95
Pine	0	0	0	0	3,814	586	0	0
Alt. 3								
Hardwood	0	0	0	0	0	0	0	0
Pine	0	0	0	0	0	0	0	0
ALT. 4								
Hardwood	0	0	0	0	3,393	1,642	512	630
Pine	0	0	0	0	3,838	562	0	0

Table 2-11. Activities and outputs associated with vegetation management activities (per decade).

Activity	Unit	ALT. 1 1st decade	ALT. 1 2nd decade	ALT. 2 1st decade	ALT. 2 2nd decade	ALT. 3 1st decade	ALT. 3 2nd decade	ALT. 4 1st decade	ALT. 4 2nd decade
Sale prep/admin	Acre	7,170	15,549	10,514	23,723	0	0	10,577	22,367
Road reconstruction	Mile	47	67	94	105	0	0	95	97
Temporary road construction	Mile	29	43	59	66	0	0	59	61
Thinning	Acre	0	0	358	217	0	0	1,142	527
Group selection	Acre	2,770	3,349	0	0	0	0	0	0
Pine conversion	Acre	4,400	7,800	4,400	7,800	0	0	4,400	7,800
Hardwood shelterwood w/ reserves (1st)	Acre	0	0	1,900	1,900	0	0	5,035	4,605
Hardwood shelterwood w/ reserves (2nd)	Acre	0	0	0	1,900	0	0	0	5,035
Hardwood shelterwood (1st entry).	Acre	0	0	3,856	3,650	0	0	0	0
Hardwood shelterwood (2nd entry)	Acre	0	0	0	3,856	0	0	0	0
Planting	Acre	3,576	4,337	6,166	7,186	2,000	2,000	5,818	7,103
Natural regeneration/ site prep	Acre	4,998	7,800	7,490	9,663	0	0	7,119	8,804
Site prep - Rx burn/BD	Acre	11,352	24,301	17,371	26,847	0	0	14,187	24,981
TSI - release	Acre	5,024	7,574	5,362	12,656	0	0	5,363	11,935
Hardwood site prep – Rx burn	Acre	5,000	5,000	66,218	66,218	0	0	64,886	64,886
Ecological Rx Burn	Acre	10,000	10,000	10,000	10,000	10,000	10,000	10,000	10,000
Artificial regeneration large openland	Acre	0	0	0	0	3,400	0	0	0
Bulldozing in wildlife openings	Acre	1,800	0	0	0	0	0	1,800	0
Wildlife openings maintenance	Acre	2,500	2,500	700	700	0	0	2,500	2,500
Large openlands maintenance	Acre	2,700	2,700	2,700	2,700	0	0	2,700	2,700

Activity	Unit	ALT. 1		ALT. 2		ALT. 3		ALT. 4	
		1st decade	2nd decade	1st decade	2nd decade	1st decade	2nd decade	1st decade	2nd decade
Blowdown	Acre	2,834	2,834	2,837	2,837	2,837	2,837	2,837	2,837
Hardwood sawtimber	Mcf	1,096	1,222	1,621	6,568	0	0	1,607	4,428
Hardwood pulp	Mcf	569	442	653	2,731	0	0	717	1,891
Total Hardwood volume	Mcf	1,665	1,664	2,274	9,299	0	0	2,324	6,319
Pine sawtimber	Mcf	2,447	4,588	2,447	4,225	0	0	2,447	4,398
Pine pulp	Mcf	4,387	5,839	4,387	6,412	0	0	4,387	6,139
Total Pine Volume	Mcf	6,834	10,427	6,834	10,637	0	0	6,834	10,537
Total Volume	Mcf	8,499	12,091	9,108	19,936	0	0	9,158	16,856
Total Volume	Mbf	50,994	72,546	54,648	119,616	0	0	54,948	101,136

The activities and outputs in the first and second decades associated with the vegetation-management program are presented in Table 2-11. The timber-harvest acreages and volume outputs include harvests for maintenance of the oak-hickory type and pine-plantation conversion on both suited and unsuited lands.

The management and control of non-native invasive species would be most aggressive under Alternatives 1, 2 and 4, each of which allows the use of pesticides. Alternative 3, which allows only manual, mechanical and limited biological control-measures, would not be as efficient as the other alternatives in the control of invasive species.

5. WILDERNESS, ROADLESS, WILD AND SCENIC RIVERS

A high level of horse use in wilderness areas on system and user-developed trails, in old road corridors and cross-country has adversely affected system trails and the natural conditions of the areas. Noise occurring outside wilderness areas from motorized use or management practices could affect the opportunity for solitude under any alternative. The absence of fire will accelerate the conversion of the oak-hickory forest-type to a more shade-tolerant, beech-maple forest-type in the long term, indirectly affecting the ecological integrity of features within wilderness. The cumulative effects of horse use on the natural condition of wilderness areas would be greatest under Alternative 1, which allows horseback-riding on user-developed trails and cross-country. Under Alternatives 2, 3 and 4, the cumulative effects of prohibiting the use of cross-country riding and user-developed trails would result in the revegetation of former travel-routes, a beneficial effect on the natural condition of wilderness. This would offer hikers away from trails greater opportunities for solitude, particularly during lower-use seasons, but could reduce the opportunity for others on the system trails.

Alternative 1, the no-action alternative, would implement the direction of the 1992 Forest Plan, retaining the Ripple Hollow area under the Wilderness Study management prescription. However, based on the roadless-area analysis performed during the Plan-revision process, no areas on the Forest (including Ripple Hollow) meet the roadless-area criteria. Therefore, no areas were evaluated for wilderness, and no areas were proposed for wilderness study under Alternatives 2, 3 or 4.

Six streams on the Forest are identified in the Plan as potentially eligible for inclusion in the national wild and scenic rivers system. They are Bay Creek, Big Creek, Big Grand Pierre Creek, Hutchins Creek, Lusk Creek and the Big Muddy River. All have an interim, Recreation, classification, except about nine miles of Lusk Creek, which has an interim classification of Scenic. A Forest-wide analysis was conducted to identify additional streams with outstanding, remarkable values and potential eligibility for inclusion into the national system. Twenty-three other streams were considered and evaluated. None met the criteria of a free-flowing condition, or possessed one outstanding, remarkable value, or would not be protected or enhanced through current management practices for riparian areas. The candidate wild and scenic rivers would be managed in a similar manner, with similar effects, under any of the alternatives.

6. MINERALS MANAGEMENT

Within the Forest proclamation boundary is the geologic potential for a variety of energy-related and industrial-use minerals and rare-earth elements. Energy-related minerals include oil, gas and coal, while tripoli, limestone and fluorite are industrial. Approximately 30 percent of the mineral estate is privately owned, either by reservation or outstanding rights. The mineral estate is generally the dominant estate. The federally owned mineral estate beneath wilderness areas is withdrawn from mineral entry and, therefore, not available for leasing under any alternative. Under Alternative 3, the entire federal mineral estate is unavailable for oil/gas leasing.

No consent-to-lease decision is made under Alternative 2, 3 or 4. However, Alternatives 1, 2 and 4 identify areas on the Forest suitable for oil and gas exploration and development, and incorporate stipulations that identify areas as unsuitable, suitable with no surface-occupancy, suitable with restricted surface-occupancy and suitable with standard stipulations.

Alternative 2 would apply no-surface-occupancy stipulations to several management areas: Cave Valley, Developed Recreational Area, Natural Area, Heritage Resource, Candidate River, as well as filter strips and riparian areas. Special stipulations would be applied to other management areas: Oakwood Bottoms, Water-Supply Watershed, Mississippi and Ohio Rivers Floodplains, Mature Hardwood and Non-Motorized Recreation. Standard lease stipulations would be applied to the remaining management areas: Even-Aged Hardwood, Large Openland, Research Area and Minimum Management. Alternative 4 applies no-surface occupancy stipulations Forest-wide.

None of the management or use activities proposed under any of the alternatives is anticipated to have any effect on the mineral resources of the Forest.

7. LAND-OWNERSHIP ADJUSTMENT

Alternative 1 identifies and maps the priorities for acquisition. It does not address statutory boundary adjustment. It directs the acquisition of only the interest required to achieve land-management objectives, rather than all available property rights. Alternatives 2, 3 and 4 identify priorities for land adjustment based on conditions/situations instead of management areas, and eliminate the land consolidation map. Each recommends adjustment of the Forest proclamation boundary to include areas of the Mississippi River floodplain, revises standards and guidelines to emphasize the acquisition of all available property rights, and allows scenic and conservation easements when management objectives are met.

The changes in land-ownership adjustment direction are expected to allow more efficient administration of the program. The effects of land-ownership adjustment on various resources are generally beneficial under any of the alternatives, because compliance with management-area–specific standards and guidelines would ensure protection of resource values.

CHAPTER 3. AFFECTED ENVIRONMENT AND ENVIRONMENTAL CONSEQUENCES

I. INTRODUCTION

This chapter offers an overview, by resource, of the physical, social, cultural and economic environment that will be affected by implementation of any of the alternative management strategies. In order to establish a basis for the comparison of the alternatives, the anticipated environmental effects—direct, indirect and cumulative—of management and use activities are analyzed, particularly as they relate to significant issues. These anticipated effects on existing conditions are discussed below following the description of each environmental resource. Generally, if no effect is anticipated, no discussion is presented.

A. DIRECT AND INDIRECT EFFECTS ANALYSIS

Unless otherwise indicated, the spatial boundary of the effects analysis includes the counties within which the Forest lies: Alexander, Gallatin, Hardin, Jackson, Johnson, Massac, Pope, Pulaski, Saline, Union and Williamson. The temporal boundary ranges generally from pre-European settlement through the life of the Forest Plan, approximately the next 15-20 years. However, the effects of some actions envisioned by the Plan are not expected to be manifested for 80-150 years, as the anticipated oak-hickory-dominated forest matures. The management and use activities to be analyzed are:

- **Restrictive Management**
  Includes implementation of filter-strip and floodplain standards and guidelines and the management prescriptions for water-supply watersheds, heritage resource significant sites, wilderness, non-motorized recreational areas and candidate wild and scenic rivers.

- **Roads and Trails Management**
  Includes construction, reconstruction, maintenance and closure.

- **Recreational Use of Trails and Roads**
  Includes authorized and unauthorized activities of hikers, equestrians, bicyclists and ATV and licensed-vehicle users.

- **Dispersed Recreational Use**
  Includes activities of hikers, equestrians, berry-pickers, mushroom-pickers, rock-climbers, picnickers and hunters and the unauthorized activities of ATV and OHM users.

- **Developed Recreational Site Use**
  Includes camping, swimming, boating and day-use.

- **Timber Harvest**
  Includes uneven-aged management with single-tree and group-selection and even-aged management with shelterwood, shelterwood with reserves and clearcutting. See Appendix C for details of harvest methods.

- **Vegetation Treatments**
  Includes tree-planting, tree-cutting, thinning, herbicide use, mowing and timber-stand improvement.

- **Fire Management**
  Includes hazardous-fuels management, fire use and wildfire suppression.

- **Integrated Pest Management**
  Includes non-native invasive species control, terrestrial and aquatic pesticide use, manual removal and spot-burning.

- **Openings and Openlands Management**
  Includes application of soil amendments, disking, plowing, bulldozing, hydro-axing, planting, seeding and prescribed fire.

- **Aquatic Resources Management**
  Includes streambank stabilization and restoration; maintenance of lakes, ponds and dams; and management of the Oakwood Bottoms Greentree Reservoir.

- **Minerals Management**
  Includes minerals extraction and oil and gas exploration and development.

- **Land-Ownership Adjustment**
  Includes land procurement and land exchange.

B. CUMULATIVE EFFECTS ANALYSIS

Unless otherwise indicated, the spatial boundary of the cumulative effects analysis includes the counties within which the Forest lies: Alexander, Gallatin, Hardin, Jackson, Johnson, Massac, Pope, Pulaski, Saline, Union and Williamson. The temporal boundary ranges generally from pre-European settlement through the life of the Forest Plan, approximately the next 15-20 years. However, the effects of some actions envisioned by the Plan are not expected to be manifested for 80-150 years, as the anticipated oak-hickory-dominated forest matures. The analysis of cumulative effects includes consideration of the combined incremental effects of the proposed management and use activities, as well as all known past, present and reasonably foreseeable future actions on and around the Forest that might have an effect on existing conditions.

Past actions on and around the Forest were farming; cattle-grazing; land-clearing of forest and oldfields for agriculture and residential developments and pine- and hardwood-plantation establishment; timber harvest; recreational facility construction and maintenance; filling of abandoned wells and cisterns; road construction, maintenance and use; powerline construction and maintenance; oil and gas exploration; wilderness designation and management of seven areas; establishment of homesteads; use of user-developed equestrian trails; authorized and unauthorized ATV and OHM use; tree-planting and timber-stand improvements, including tree-thinning and the use of herbicides; use of off-highway and sport-utility vehicles and trucks; outdoor recreation (e.g., camping, hunting, fishing, hiking, horseback-riding); wildfires and fire use; fire suppression; wildlife-opening construction and maintenance; hunting and collecting of artifacts; pond and waterhole construction; levee construction; mining; oil and gas exploration and development; and railroad construction and use.

Present actions on and around the Forest include trail construction, use and maintenance; powerline maintenance; authorized and unauthorized ATV and OHM use; timber harvest (mainly on private lands); agricultural management (row-cropping and pasturing) on private lands; fires (wild and prescribed) and fire suppression; use of user-developed equestrian trails; road maintenance and use; tree planting; railroad maintenance and use; establishment and operation of private equestrian campgrounds; recreational facility management and maintenance; wilderness management; outdoor recreation; mining and oil and gas exploration and development.

Reasonably foreseeable future actions on and around the Forest include all of the above-listed present actions as well as those proposed in the Forest Plan revision.

Irreversible and irretrievable commitments of resources are typically addressed in any analysis of environmental effects. However, since such commitments of resources are usually made at the project level rather than the programmatic level of a Forest Plan, they will not be specifically identified in this chapter.

II. ENVIRONMENTAL SETTING

The SNF is located in southern Illinois (see locational map on reverse of title page). The 1933 "proclamation boundary" and the Shawnee Purchase Unit include 839,758 acres. As of January 1, 2004, 285,230 acres are being administered as part of the National Forest System, about 34 percent.

The Forest was developed on land acquired during the 1930's that had been farmed-out, over-cut, over-grazed and severely burned. Initial efforts were to reforest open areas, stop erosion and protect the forest from fire. This acquisition and reforestation process principally determined the character of the SNF today: scattered blocks of national forest of tens to several thousand acres surrounding and surrounded by private pasture, farm, woodland or small communities.

The topography of the Forest is rolling to rough hill-land characterized by many bluffs. This is in marked contrast to the general flatness of Illinois north of the Forest, where glaciers and glacial outwash planed off or filled in the bedrock topography. Elevations above sea level on the Forest range from approximately 325 feet at the southwestern corner to 1,064 feet at Williams Hill in northeastern Pope County.

The climate of southern Illinois is mild, with short winters and long, hot, humid summers. The average annual precipitation is 43 inches, 22 inches of which occurs between April and September. Annual snowfall averages about 16 inches, with the greatest accumulations in January. The length of the growing season is about 200 days. This long season and ample precipitation are favorable for the rapid and abundant growth of vegetation.

III. PHYSICAL AND BIOLOGICAL CHARACTERISTICS

The physical and biological characteristics of the Forest and the effects anticipated on them of implementing the alternatives are described here. Consideration of the demand for various goods and services, as well as of the current use of the Forest's resources, plays an important role in determining the effects of any of the alternatives. The information provided about the existing resource conditions sets the stage for these determinations.

A. SOIL AND WATER

1. SOIL

The Natural Resource Conservation Service (NRCS), formerly the Soil Conservation Service, over the past 25 years has surveyed and mapped the ten counties on which the SNF is located as part of the national cooperative soil survey program. Soil surveys provide general information about soil types and their suitability and limitations for certain uses and management. They also provide information about climate, relief, land use and the geology and physiography of the area.

As part of the survey, the NRCS described the characteristics of the soil and the parent material from which it formed. This included information about the five soil-forming factors that help define every soil series: parent-material, topography, climate, time and inherent plant and animal life. Soil parent-materials on the Forest include glacial drift, loess, alluvium, lacustrine sediments, cretaceous gravels and weathered bedrock.

Loess is the most important soil parent-material on the Forest. Once the glaciers began to retreat, meltwaters deposited sediments in river valleys. This melting was followed by a dry, windy climate that deposited these silty sediments across the upland landscape. Loess deposits are thickest near the source, the Mississippi River and Ohio River valleys. Loess depths of 25 to 30 feet are not uncommon along the Mississippi River bluff. Loess deposits are thinnest in Saline and northern Pope Counties, ranging from five to eight feet on stable landscapes. On steep slopes, most loess has been eroded away through geologic processes and soils have developed in bedrock or thin loess and bedrock. Alford and Menfro soils are soils developed entirely in loess. Wellston soils developed in both loess and the underlying bedrock. Berks and Muskingum soils developed primarily in bedrock.

Most soils on steep slopes developed in bedrock on the Forest. Soils on moderate slopes developed in a combination of loess and bedrock. The types of bedrock include Pennsylvanian-age sandstones and shale; Mississippian-age sandstone, shale and limestone; and Devonian- and Silurian-age chert and limestone. The type of bedrock parent-material significantly influences soil characteristics such as water-holding capacity, pH and rooting depth. Berks and Muskingum soils formed in Pennsylvanian- and

Mississippian-age sandstones, Goss soils in Devonian-age cherty limestone and Beasley soils in calcareous shale.

Lacustrine sediments are deposited in former glacial lakes. The Big Muddy River valley was a glacial lake during the Wisconsinan stage of the Pleistocene period (glaciation). Fine clayey sediments were deposited in the stagnant water. The thickness of these deposits ranges from 30 to 60 feet and, in some places, is as much as 150 feet. Textures of these materials are related to the energy of the water at the time of deposition. Jacob and Booker soils formed in lacustrine sediments and have greater than 60 percent clay in the subsoil. Oakwood Bottoms Greentree Reservoir is located primarily on these soils. They are well suited for wetland and water management.

Cretaceous- and Tertiary-age sands and gravels are parent-material for many soils in the southern part of Pope and Massac Counties. These materials were deposited at the north end of the former Mississippi embayment of the gulf coastal plain when ocean shorelines occupied parts of southern Illinois. The gravel is called Mounds gravel and is predominantly medium to dark brown chert pebbles with a glossy surface in a matrix of coarse, red sand. Most pebbles are partly rounded to well-rounded. Brandon and Lax soils developed in loess and the underlying coastal plain sands and gravels. Saffell soils developed entirely in the sands and gravels.

The Illinoisan glacier-advance around 75 to 100 thousand years ago reached only the northern fringes of what is now the Forest. The northwest part of the Forest around Kinkaid Lake offers evidence of glaciation. Glacial drift—the parent material remaining following glacial retreat—is typically a mixture of sand, silt and clay and rock fragments influenced by the local bedrocks. Hickory soils are formed in glacial drift and are of very small extent on the Forest.

Soils on floodplains have developed in alluvium. Alluvium is a parent-material that consists of water-laid sediments deposited during floods. These sediments are usually a mixture of sand, silt, or clay. Most soils on small, narrow floodplains have a high component of silt. Sharon and Belknap soils are formed in silty alluvium and are usually located on small floodplains. Larger floodplains, such as of the Mississippi and Ohio Rivers, have a wide range of alluvial soils and textures, from very sandy to very clayey. Sarpy soils developed in sandy alluvium, while Karnak soils have developed in silty-clay textures.

The suitability and limitations on management of the soils on the Forest can be found in Plan Appendix F. It describes management limitations on activities, such as building roads and trails and treating areas with prescribed fire. It also contains standards and guidelines for seeding disturbed areas and installing water-control structures. Interpretations were generated using the NRCS National Soil Survey Handbook (NSSH) and the National Soil Information System (NASIS).

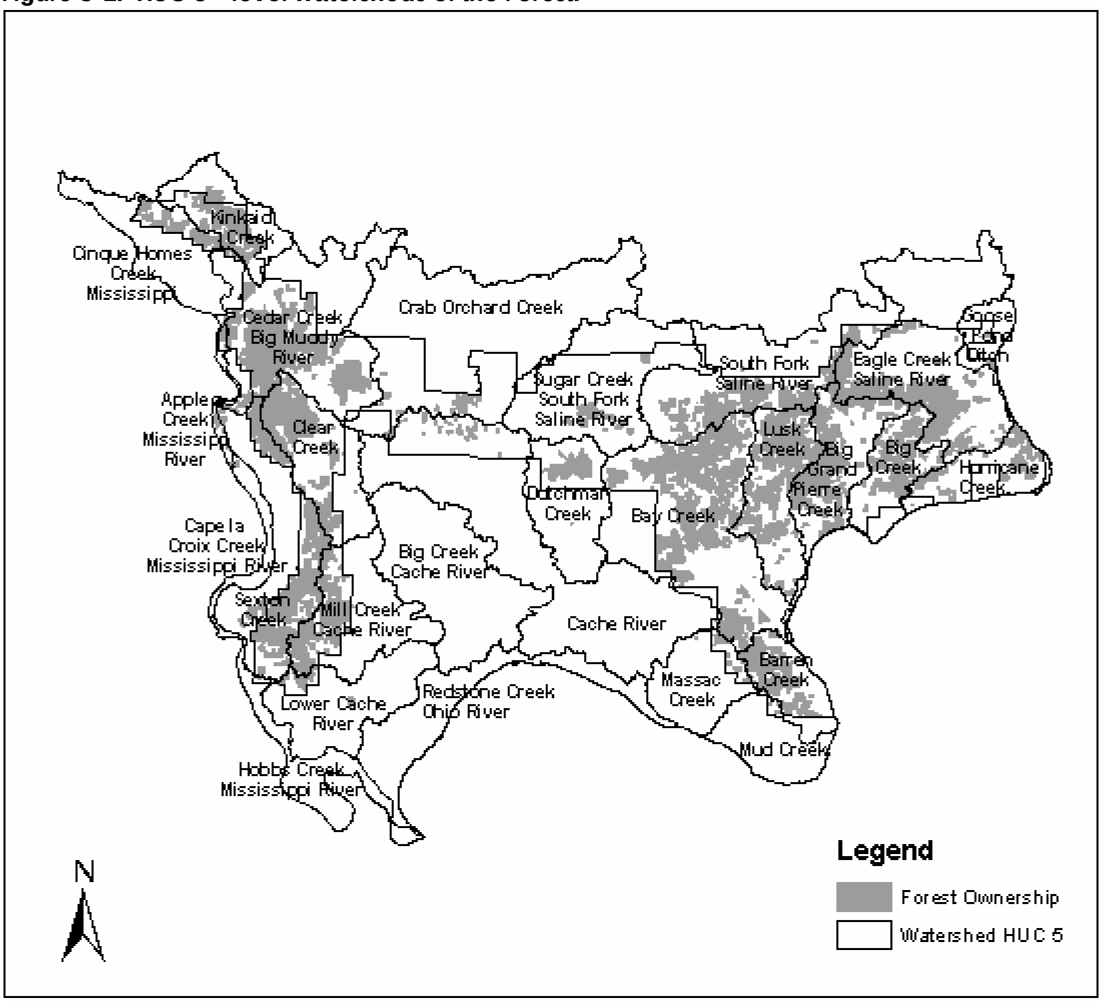
2. WATER QUALITY

Undisturbed forested watersheds produce high-quality streams with excellent water quality. Actions that disturb the landscape, such as roads, development, agricultural activities, mining and impoundments, can increase point and non-point sources of pollution and alter the hydrology of streams. These pollutants can include residential sewage, commercial fertilizer, sediment and soil nutrients, agricultural pesticides and acidic mine-drainage. Many of the watersheds with a high percentage of national forest land have good water quality, such as Lusk Creek. Due to the fragmented and dispersed pattern of national forest ownership, some of the watersheds that drain the national forest lands have poor water quality. For example, the South Fork of the Saline River has fair to poor water quality, due to acidic mine-drainage from inactive coal strip-mines.

a. Hydrology

The Forest is located in 25 watersheds ranging in size from less than 3,000 acres to about 185,000 acres (Table 3-1). In this analysis, a watershed refers to a fifth-level hydrologic unit code (HUC) watershed, which is a hierarchical labeling system for drainage basins of different sizes. Land ownership is highly fragmented within these 25 watersheds, which drain nearly 1.7 million acres. Understanding the relationships between land and water in these watersheds is important for predicting the effects of land-management activities.

Figure 3-1. HUC 5th-level watersheds of the Forest.



Approximately 304 miles of perennial streams and 755 miles of intermittent streams flow through national forest lands. Land within the Forest boundary contributes an estimated 784,000 acre-feet of water per year to the area's hydrologic system (one acre-foot of water equals one acre of surface water at a depth of one foot). Groundwater volumes within the planning area are relatively stable. Geologically, many soils are underlain by perched water tables that seasonally approach or meet the surface.

Surface-volumes of water vary from year to year depending on precipitation. The average annual precipitation for the forest is 44 inches. Flooding usually occurs annually on parts of the Forest. Deficiencies occur every few years, drying up most intermittent streams and dropping impoundment levels several feet. In one out of five years, the area can expect rainfall to be fifteen percent or more below average and, likewise, in one out of five years, the area can expect rainfall to be fifteen percent or more above normal.

The Anna-Jonesboro, Millstone, South Water and Saline Valley Conservancy Districts supply municipal water to much of the area using groundwater wells. Kinkaid Lake supplies municipal water to most of Jackson County through the Kinkaid-Reeds Conservancy District. Cedar Lake provides water to Carbondale, Little Cedar Lake to parts of Union County. Lake of Egypt supplies water to parts of Williamson and Johnson Counties, and Vienna City Lake to Vienna. No substantial change in demand is anticipated in the ten-to-fifteen-year planning period.

b. Streams

Table 3-1. Forest streamwater–quality rating: IEPA-305b Report 2004 (IEPA/BOW/04-006).

HUC 5th-Level Watershed	Forest Ownership (%)	IEPA Water-Quality Rating
Apple Creek – Mississippi River	20	Not assessed.
Barren Creek – Ohio River	34	Not assessed.
Bay Creek	31	Full and partial support
Big Creek – Ohio River	30	Full support
Big Grand Pierre Creek – Ohio River	37	Full support
Cache River	1	Full support
Lower Cache River	3	Partial support
Cape la Croix Creek – Mississippi River	1	Not assessed.
Cedar Creek – Big Muddy River	28	Partial, full and non-support
Cinque Homes Creek – Mississippi River	9	Not assessed.
Clear Creek	30	Full and partial support
Crab Orchard Creek	1	Partial support
Dutchman Creek	7	Full and partial support
Eagle Creek – Saline River	20	Full support (partial assessment)
Goose Pond Ditch – Ohio River	2	Not assessed.
Hobbs Creek – Mississippi River	0	Not assessed.
Hurricane Creek – Ohio River	18	Not assessed.
Kinkaid Creek	27	Full support
Lusk Creek	42	Full support
Massac Creek – Ohio River	2	Not assessed.
Mill Creek – Cache River	19	Partial and full support
Mud Creek – Ohio River	1	Not assessed.
Sexton Creek	31	Full support
South Fork Saline River	17	Partial, full and non-support
Sugar Creek – South Fork Saline River	3	Full support

The 2004 Illinois Water Quality report was prepared by the IEPA to satisfy reporting requirements in Section 305(b) of the federal Clean Water Act. The report is an assemblage of data collected from several monitoring programs. The IEPA is responsible for protecting and regulating the many beneficial uses of the state's surface-water resources. Several beneficial uses have been officially designated in Illinois Pollution Control Board rules and regulations. For each applicable designated use in each water body, the IEPA determines the degree to which the designation is attained. These use-support assessments are how the IEPA reports the resource quality of Illinois surface waters in the 305(b) report.

c. Lakes

Lakes on the Forest include Kinkaid, Cedar, Lake of Egypt, Glen O. Jones, Pounds Hollow, Glendale, One Horse Gap, Tecumseh, Whoopie Cat, Dutchman, Little Cache #1, Little Cache #5, Bay Creek #5 and Bay Creek #8. The first two are cooperative lakes constructed as sources for community water and for national forest purposes; the latter five are PL 566 flood-control structures wholly or partially on national forest land.

Table 3-2. Forest lake-water-quality rating: IEPA-305b Report 2002 (IEPA/BOW/02-006).

Lake	Level of Support – Overall Use
Bay Creek No. 5	Full support
Cedar	Full support
Dutchman	Partial support
Glen O. Jones	Full support
Glendale	Full support
Lake of Egypt	Full support
Little Cedar	Partial support
Kinkaid	Partial support
One Horse Gap	Full support
Pounds Hollow	Full support
Sugar Creek	Partial support
Tecumseh	Full support

Lake of Egypt is primarily a cooling lake for an electricity-generating facility. National forest land borders a portion of the lake. Glen O. Jones Lake is managed primarily for recreation by the IDNR. There is some national forest land inundated by the lake and some in the watershed. The other lakes are entirely national forest lakes and are primarily managed for recreation and wildlife.

The Little Grassy, Devil's Kitchen and Crab Orchard lakes are within the Crab Orchard National Wildlife Refuge managed by the US Fish and Wildlife Service. A minor amount of national forest land is inundated by Devil's Kitchen. Lake-water-quality monitoring is conducted by the IEPA and includes biological, water, sediment, in-stream habitat and fish-tissue samples collected under several monitoring programs, including the Ambient Lake Monitoring Program, the Illinois Clean Lakes Monitoring Program and the Volunteer Lake Monitoring Program. The monitoring and evaluation results determine whether lake-water-quality is meeting standards that will support the lake's designated use (see Table 3-2).

d. Wetlands and Floodplains

Wetlands provide valuable habitat for 40 percent of the state's threatened and endangered species. In addition, wetlands store floodwater, improve water quality, help recharge groundwater and provide recreation. Public demands for flood control, agriculture and development continue to threaten remaining wetlands with modification, degradation and conversion. Alterations include dredging, filling, draining and constructing levees.

About 15 percent of the Forest is either floodplain or wetland. Of this area, aabout 7,000 acres are wetlands. A majority of the wetlands are located on the historical Mississippi River floodplain and were in agricultural production for many years prior to Forest Service acquisition in the mid-1990's. Wetland restoration has been ongoing since 1996 and many wetland values have been returned to the area. Forest Service activities in wetlands and floodplains must comply with Executive Orders 11988 and 11990 that emphasize the protection of floodplains and wetlands.

e. Groundwater

About 50 percent of the population of Illinois (5.5 million people) relies on groundwater for its water supply (IEPA, 1992). One thousand four hundred fifty communities obtain their potable water from groundwater sources. In addition, more than 60 percent of the water in intermittent and perennial streams and rivers originates from groundwater. Hence, the protection and conservation of groundwater have far-reaching implications.

Geologic conditions on most of the Forest are favorable for obtaining small supplies of groundwater; but many shallow, domestic supplies prove to be inadequate year-round. Development of larger, more dependable supplies is problematic. Deposits of water yielding sand and gravel are limited in southern Illinois to well known and well defined areas, generally along the Mississippi, Ohio, Wabash and Cache Rivers. These deposits of sand and gravel are absent on most of the Forest (very little of which is underlain by any alluvium), so wells are completed in shallow limestone or sandstone. Published water-quality data for public groundwater supplies are available from the Illinois State Water Survey for Alexander, Hardin and Massac Counties. Public wells in these counties within and adjacent to the Forest boundary range from 80 to 1,030 feet.

Groundwater quality is highly variable. Groundwater aquifers are water-bearing units of porous, permeable rock or unconsolidated sediments. Water from the unconsolidated deposits (sand and gravel) is generally good quality, as is the water from some of the bedrock aquifers. But water quality tends to decrease with depth, due mostly to increasing dissolved solids (like salt and other minerals). In southern Illinois, water from deeper than 250 feet is too salty for many uses. Extensive faulting may allow the poor water quality to intrude to even shallower depths. However, in the intensely faulted area around Hicks Dome, potable water extends to more than 1,000 feet below the surface. In some areas, sandstone aquifers containing fresh water are overlain by less permeable rocks containing highly mineralized water.

Most SNF recreation areas and administrative buildings receive their water sources from municipal supplies, either directly from municipal lines or from hauled water. The only exceptions to this are Iron Furnace and Johnson Creek recreation areas, which are supplied from drilled wells. Every other year, the Illinois Department of Public Health (IDPH) conducts inspections of the water sources supplied by the Forest. To comply with state regulations, potable water and beach water are regularly analyzed by the IDPH Laboratory in Carbondale. If potable water does not meet IDPH standards, it is required to be treated or replaced with potable water meeting standards before re-opening the supply for public use. Beaches that are found out of compliance are closed until water quality is restored.

DIRECT AND INDIRECT EFFECTS ON SOIL AND WATER

The spatial boundary of the analysis of effects on soil and water resources includes the HUC 5th-level watersheds that drain the Forest. These include Kinkaid Creek, Cape la Croix Creek-Mississippi River, Cedar Creek-Big Muddy River, Cinque Homes Creek-Mississippi River, Crab Orchard Creek, Eagle Creek, Goose Pond Ditch-Ohio River, Hobbs Creek-Mississippi River, Hurricane Creek-Ohio River, Sexton Creek, South Fork Saline River, Sugar Creek-South Fork Saline River, Big Grand Pierre Creek, Clear Creek, Lusk Creek, Dutchman Creek, Bay Creek, Apple Creek-Mississippi River, Big Creek, Mill Creek, Cache River, Massac Creek, Barren Creek, Lower Cache River and Mud Creek.

Surrounding watersheds are not considered because they do not contribute runoff or sediment across watershed boundaries. Several of the watersheds drain directly into either the Ohio or Mississippi Rivers, but most of them act as sub-watersheds to larger basins. For example, Sugar Creek drains to the Ohio River via the South Fork of the Saline River and the Eagle Creek-Saline River watershed. Dutchman Creek, Cache River, Mill Creek, Clear Creek, Kinkaid Creek and Crab Orchard Creek watersheds all contribute to larger streams or rivers before entering either the Ohio or Mississippi River. Changes in the amount of sediment contributed from these watersheds to the larger basins, due to differences among the alternatives, would not be measurable in the larger basins, and would be of little consequence in the larger watershed picture.

The temporal boundary of the analysis is the life of the Plan, or 15-20 years. In general, erosion and sedimentation resulting from projects completed more than five to ten years ago are no longer eroding at an accelerated rate (significantly more than geologic erosion rates). Overall, disturbances resulting from past timber harvest, fire management and wildfires have stabilized and support vegetation. The effects of more-recent action may be ongoing and will be considered cumulatively in the analysis.

Forest management activities have the potential to affect soil quality through accelerated surface-soil erosion, compaction, displacement, puddling and rutting. Erosion affects soil productivity by carrying away soil particles and nutrients tied to the soil. Compaction can reduce the porosity of the soil, and rutting and puddling can damage soil structure. Reduced porosity and damaged soil structure limits moisture and gas exchange, which can adversely affect the productive capacity of the soil. The Forest will assess all proposed actions for site-specific effects in order to avoid impairment of soil resources in the long term.

The most common water-pollutant from the types of agricultural/forestry activities considered in the analysis is sediment from non-point sources. Activities that disturb the soil increase the potential for erosion and subsequent transport of some of the eroded sediment to adjacent waterbodies. Too much sediment can adversely affect water quality. Other potential, adverse effects that could result from management activities proposed under the alternatives include changes in turbidity, nutrient enrichment from fertilizer runoff, changes in water quantity and changes in water temperature.

Management and use activities addressed in this FEIS are listed at the beginning of Chapter 3. The following analysis discusses and compares the effects of the different alternatives on soil and water resources. A discussion of the direct and indirect effects is followed by an analysis of cumulative effects. Table 3-3 presents a summary of the direct and indirect effects on soil and water resources.

Table 3-3. Summary of direct and indirect effects on soil and water resources.

Resource Indicators			Unit of measure	Alternative 1	Alternative 2	Alternative 3	Alternative 4
Riparian Resources	**Riparian Resources included in Riparian Filter-Strip S&G**		**Type of Stream**	**Perennial and Intermittent Streams**	**Perennial, Intermittent and Ephemeral Streams**	**Perennial, Intermittent and Ephemeral Streams**	**Perennial, Intermittent and Ephemeral Streams**
Soil Quality	Potential for actions to adversely affect soil quality	Recreation	relative	low	remote	remote	remote
		Fire Management	relative	remote	remote	remote	remote
		Timber Harvest	relative	low	low	none	low
		Minerals	relative	low	low	none	none
Water Quality	**Areas managed under WW mgmt prescription.**		**Acres**	0	17,400	17,400	17,400
	Potential for actions to adversely affect water quality	Recreation	relative	low-moderate	low	low	low
		Fire Management	relative	low	low	low	low
		Timber Harvest	relative	low	low	none	low
		Minerals	relative	low	low	none	low

Table 3-3 shows the effects of possible Forest management activities on soil and water resources by alternative. The effects are shown in relative terms on a scale from high to low. Site-specific analysis would be done when management activities are proposed, providing a more complete view of the effects.

The overall effects of management activities on soil resources would be similar under any alternative. The slight differences are based on the range of possible management intensity of the recreation, timber, mineral and fire programs.

1. Restrictive Management

a. Filter-Strip Guidelines

Some management activities can cause adverse effects on soils, such as compaction, rutting and erosion. Plan management standards and guidelines under any alternative define filter strips adjacent to intermittent and perennial streams, lakes and wetlands that would provide protection from soil erosion and sedimentation. Alternatives 2, 3 and 4 propose to include ephemeral streams. These filter strips would protect riparian functions by avoiding or reducing ground-disturbing activities in these sensitive areas. Forested riparian filter strips trap large debris and sediment, slow floodwaters and reduce flood-peaks, provide riparian habitat for wildlife, stabilize streambanks, shade streams and regulate water temperature.

Alternative 1 would maintain the filter strips as defined in the 1992 Forest Plan, specifically, a 100-foot filter strip along intermittent streams and lakes, 200 feet along perennial streams and 25 feet along lakes. This doubled the NFMA requirement that special attention be given to land and vegetation "for approximately 100 feet from the edges of all perennial streams, lakes and other waterbodies." The Clean Water Act required the states to develop best-management practices to control point- and non-point-sources of pollution. In 2000 the IDNR published best-management practices that established stream-management zones (filter strips) using land slope as a determining factor. Based on the NFMA requirement and IDNR's best management practices and stream-management zones, the Forest proposes under Alternatives 2, 3 and 4 to revise filter-strip widths to correspond with the state's stream-management zones. (See Forest-wide standards and guidelines.) The proposed filter-strip widths have been found to be effective at reducing non-point-source pollution (Curtis *et al.*, 1990; Coltharp, undated; Lynch and Corbett, 1989).

Table 3-4. Filter-strip guidelines proposed under Alternatives 2, 3 and 4.

Adjacent Land Slope	Intermittent Stream Filter-Strip Width (in feet)	Perennial Stream Filter-Strip Width (in feet)
<10 percent	50	100
20	65	130
30	85	170
40	100	200
50	125	250
60+	150	300
From edge of wetlands,100 feet; from edge of ephemeral streams, 25 feet.		

The minimum proposed width of filter strips along perennial streams and lakes is 100 feet, but it can range up to 300 feet, based on the adjacent land-slope; along intermittent streams, 50 feet with a range up to 150 feet; along the exterior edge of wetlands, 100 feet; and ephemeral streams, 25 feet (Table 3-4). All filter-strip widths will be measured from the edge of the stream, lake or wetland. The slope-adjustment increases filter-strip widths on steep slopes where the risk for erosion is highest (Dissmeyer, 1984).

The filter-strip widths proposed under Alternatives 2, 3 and 4 compare well with those recommended by the Forest Service, Northeastern Area (Welsch, 1991) and the NRCS to control erosion and sedimentation of surface waters from timber-harvesting activities (Table 3-5); and by the NRCS. The NRCS Conservation Practice Standard for the USDA Riparian Forest Buffer program has a minimum filter strip of 50 feet along first- and second-order streams (intermittent) and 100 feet along third-order (perennial) and larger streams. There are no slope adjustments of the filter-strip width.

Table 3-5. Recommended filter strips: FS Northeastern Area, state and private forestry.

Percent Slope Adjacent to the Stream	Recommended Width of Filter Strip
0-1	25
2-10	30-50
11-20	50-70
21-40	70-110
41-70	110-170

Several studies confirm the effectiveness of filter-strip widths as proposed:

In Tennessee, best-management practices were used during logging on the Pickett State Forest to protect the water quality of adjacent streams. Best-management practices were strictly adhered to and monitored as described by the Tennessee Division of Forestry. In Rock Creek, total suspended solids (TSS) concentrations ranged from the detection limit of one-tenth milligram per liter to 18 and four-tenths milligrams per liter prior to timber harvest. Average TSS concentrations in Rock Creek immediately upstream and downstream from the stand after harvest activities began were three milligrams per liter and five milligrams per liter. Clearly, the transport of suspended solids within the watershed was not adversely affected by timber harvest (Curtis *et al.*, 1990). Table 3-6 notes the Tennessee streamside management-zone (filter-strip) widths.

Table 3-6. Streamside management-zone widths as a function of land-slope adjacent to stream (Tennesseee Department of Conservation, 1985)**.**

Slope of Land between Disturbed Area and Stream or Other Waterbody	Recommended Stream Management-Zone Width (in feet)
0	25
10	45
20	65
30	85
40	105
50	125
60	145

A University of Kentucky study evaluated the effectiveness of best-management practices, including filter strips along perennial streams, to protect water quality and reduce sedimentation. The size of the filter strips studied is listed in Table 3-7. In the study, clearcut harvesting was done on two watersheds, beginning in August 1983 and ending in May 1984. Best-management practices were implemented during and after logging in one watershed, a “loggers’ choice” operation was conducted on another, and a third watershed was left undisturbed as a control. The mean post-harvest suspended-sediment production was greatest from the loggers’ choice watershed—.29 ton per acre per year; the next was from the best-management practice area—.16 ton per acre per year, and the smallest was from the control area—. 06 ton per acre per year (Coltharp, undated).

Table 3-7. Filter strips used in University of Kentucky study.

Slope of Land between Disturbed Area and Stream	Recommended Filter-Strip Width (in feet)
0	25
10	45
20	65
30	85
40	105
50	125
60	145
70	165

In West Virginia the effects of three silvicultural and streamside management practices on sediment-loss, water temperature and nutrient-export were evaluated on experimental watersheds in north-central West Virginia. The practices were clearcutting an 85-acre watershed, mechanically site-preparing a 29-acre watershed, and cutting a 96-acre watershed to a 14-inch stump height. A filter strip was established adjacent to perennial streams to buffer the effects of these practices. Average filter-strip width was 66 feet in two watersheds and 160 feet in a third. No silvicultural treatment significantly increased sediment yields on any of the watersheds. Similarly, the treatments had little effect on stream-water temperature, though electrical conductivity and nitrate-N concentrations increased slightly on all three watersheds.

In Pennsylvania, ten years of streamflow and water-quality data were evaluated to determine the effectiveness of best-management practices in controlling non-point source pollution from a 110-acre commercial clearcut. A 100-foot protective buffer-strip was left on each side of all perennial streams (Lynch and Corbett 1989). Overall, the best-management practices employed were very effective in preventing serious deterioration of stream quality as a result of forest harvesting.

These studies demonstrate that filter strips with dimensions similar to those proposed under any alternative have been effective in protecting water quality. Alternatives 2, 3 and 4 specify filter strips equal to or wider than those in the referenced studies and should sufficiently protect soil and water resources from various management and use activities. These alternatives would provide a greater degree of protection on steep slopes than Alternative 1, but somewhat less on less-sloping areas. Overall, the level of protection would be slightly greater than Alternative 1 because the more steeply sloping areas that are potentially more erodible would be better protected. These alternatives also specify a filter strip along lakes similar to that of perennial streams—a minimum of 100 feet—providing more protection to lakes than Alternative 1.

b. Floodplain Management

Alternatives 2, 3 and 4 propose a new management prescription (MO) that would include 8,600 acres of the Mississippi and Ohio Rivers floodplains. This prescription would emphasize the restoration of wetland function. Alternative 1 would continue management of these areas under filter-strip and riparian management guidelines. All alternatives would protect these areas; however, Alternatives 2, 3 and 4 would focus on wetland restoration, function and management.

c. Candidate Wild and Scenic Rivers

Alternative 1 would continue to manage all candidate streams as eligible for the "scenic" classification, restricting recreational development and vegetation treatment along the streams. Implementation of this alternative would generally result in beneficial direct and indirect effects.

Alternatives 2, 3 and 4 would manage the six streams as eligible for a "recreational" classification, except for the section of Lusk Creek located in wilderness that would be managed as eligible for "scenic" classification. The management prescription for candidate streams will correspond with their classification. Effects from potential, allowable development could be soil erosion, compaction, reduction of soil productivity and sedimentation. However, with the protections afforded by implementation of the proposed filter-strip guidelines, implementation of Alternatives 2, 3 and 4 would result in only minimally adverse direct and indirect effects on soil and water resources, affording slightly less protection than under Alternative 1.

d. Wilderness

Managing national forest land as wilderness benefits soil and water resources because of the prohibition on motorized ground-disturbing activities, such as building roads, harvesting timber and mining. The effects of wilderness management on soil and water would relate mainly to the dispersed, non-motorized recreational use of wilderness. The use of hiker-equestrian trails in wilderness would affect soil and water resources because of erosion, compaction and sedimentation. Effects of recreational use are discussed in section 3, below. Since unauthorized all-terrain vehicle-use might also occur in wilderness, the effects of such use are described in section 4, below.

Implementation of Alternative 1 would result in greater, adverse, direct and indirect effects than the other alternatives, because even though the 1992 Forest Plan specifies wilderness trail-density at one mile per square mile, the Plan's allowance of cross-country riding would remain. (The effects of cross-country riding are discussed in section 4b, below.) Implementation of Alternatives 2 and 4 would result in minimally adverse, direct and indirect effects, even though they specify no trail-density standard in wilderness areas. These alternatives would eliminate the adverse effects of cross-country riding because equestrians, a major user-group in the wilderness, would be restricted to a system of better-located and maintained trails.

Implementation of Alternative 3 would result in the least adverse direct and indirect effects of all alternatives because trail densities would not be allowed to exceed one mile per square mile and cross-country riding would not be allowed. Additional protection would be afforded by a wintertime seasonal closure that would be imposed, preventing use not only during the wettest time of the year (on average), but also during the freeze-thaw cycles of late winter and early spring that render the soil very susceptible to compaction and erosion.

The Illinois Wilderness Act of 1990 withdrew wilderness areas from mineral exploration and development, so there would be no direct or indirect effects on soil resources in wilderness from exploration and development.

e. Non-motorized Recreation

Non-motorized recreation includes hiking, biking, rock-climbing and horseback riding. (See sections 3a, 4b and 4c for more details on the effects of these activities.) Of the non-motorized recreational activities, horseback riding has the greatest potential to adversely affect soil resources (Wilson and Seney, 1994). Implementation of Alternative 1 would result in the greatest adverse direct and indirect effects because it allows cross-country riding. The effects of cross-country riding are discussed in section 4b. Implementation of Alternatives 2, 3 and 4 would result in minimally adverse, direct and indirect effects on soil and water resources because equestrian use would be restricted to better-located and maintained system trails.

f. Water-Supply Watershed Management

Kinkaid Lake, Cedar Lake, Little Cedar Lake and Lake of Egypt are reservoirs that provide public water-supplies to many throughout southern Illinois. It is important that the quality of these public water-resources is maintained or improved for both public health and economic reasons. The watersheds that drain into these waterbodies contain about 9 percent Forest land at Lake of Egypt, 30 percent at Cedar Lake and 26 percent at Kinkaid Lake.

A water-supply watershed management prescription (WW) is proposed to protect these resources. This prescription would emphasize the protection of water supplies through the implementation of filter-strip guidelines and the IDNR best management practices, shoreline-stabilization and the restriction of new road construction. Management activities that could occur include prescribed fire, temporary road construction and maintenance, openings maintenance, pond maintenance and non-native invasive species control.

The WW management prescription is proposed under Alternatives 2, 3 and 4, although Alternative 3 would not allow vegetation management or road construction. Alternative 1 would continue management of these areas under the mature hardwood (MH) management prescription, which emphasizes the management of mature, hardwood forest, generally in proximity to areas with high recreational use, with emphasis on wildlife habitat and recreation. Timber harvest for reasons other than wildlife habitat or ecosystem restoration, and cross-country equestrian use would be allowed under this prescription. The shift in management emphasis in these watersheds, from mature-forest management to the protection of public water supplies in the reservoirs focuses attention on these important public resources.

The WW management prescription also restricts some ground-disturbing activities, which would result in less soil erosion and subsequent sediment entering the reservoirs. Among the alternatives, Alternative 3 restricts ground-disturbing activities the most. It provides the most protection for the water-supply watersheds; Alternatives 2 and 4 provide equal protection and Alternative 1 provides the least.

2. Roads and Trails Management

Land dedicated to the transportation system is removed from the productive land base. Construction and use of transportation facilities, such as roads and trails, can result in compaction and rutting and increase the potential for accelerated erosion over geologic rates. Some of the eroded soil can enter nearby streams, where it can degrade aquatic habitat and lower water quality (USDA, 2000a; USDA, 2000b). The presence of roads can also increase the nutrient delivery to streams by removing vegetation, modifying the surface hydrology and increasing sediment delivery (Gucinski *et al.*, 2001; USDA, 2000c). Clinton and Vose (2003) found that roads are the major sources of sediment in most forested watersheds.

The main factors influencing the amount of soil eroded are slope-length, tread-gradient, landscape-slope, soil erodibility, soil infiltration-rate and the intensity and duration of rainfall occurrences. Some of these factors are intrinsic to southern Illinois, such as the erodibility of the soils, slope of the landscape and climate. Manipulating other aspects of trail location and design can reduce soil loss. These include trail-gradient, slope-length and the total miles of trail in the travel-route system. The amount, timing and type of use can also influence the amount of erosion. Roads and trails removed from the system would stabilize either naturally, or through actions taken to stabilize the area, and productivity would slowly return through decades of freeze-thaw, plant growth and natural organic inputs.

Properly located and maintained travelways can protect the nearby resources when their use does not exceed design specifications. Properly located travelways follow land contours (across the slope, not up and down slopes) and minimize stream crossings. Use of water-control structures that shorten the length-of-slope and surfacing with gravel on steep slopes and at stream-crossings can substantially reduce erosion and sedimentation. Trails hardened with gravel can bear heavier loads, while minimizing the effects of compaction and erosion. Gravel protects the trail surface from rainfall impact and the displacement of soil particles that could later be moved away by runoff (Aust *et al.*, 2005; Flerchinger and Watts, 1987). Road- and trail-cuts can create slopes that are nearly vertical, creating the potential for mass movement of soil because soil shear-stress increases as slope increases (Ritter 1986). Mass movement can happen anywhere on the forest; but deep, loess soils are especially susceptible because they are unstable and lack cohesion. Deep, loess soils are common on the west side of the forest in counties adjacent to the Mississippi River. Road- and trail-cuts through bedrock are more stable and more resistant to mass-wasting.

There are low-water crossings on the Forest that can accumulate debris and restrict the movement of bed-load downstream. Maintenance generally corrects this problem. Bridges are typically single span and do not restrict movement of bed-load.

Roads can affect wetlands and riparian areas by direct encroachment or through changes in hydrology. Road ditches can affect both surface and subsurface drainage to the point that the water-table is lowered, changing the moisture regime of a wetland. Trails generally do not affect wetlands and riparian hydrology.

Roads are sometimes located in narrow floodplains in high-relief, dissected uplands. In this situation, roads are sometimes located adjacent to the stream and stream-channel movement can scour into the road right-of-way. Streambanks then have to be armored and the road moved as a result. Where a road parallels a stream, shade could be reduced along with vegetation protecting the stream bank. This could increase stream-water temperatures and streambank erosion.

Where roads and streams intersect or are parallel, there is a reduction in canopy-cover over the stream. Reduction in canopy-cover can increase the amount of sunlight reaching the streambed and banks, increasing stream water temperature. Changes in light and temperature within the aquatic environment can alter breeding schedules and food availability. Increased sunlight can also stimulate algal growth, making it more difficult for some species of fish to feed. It can also change the make-up of riparian plant communities from shade-tolerant to shade-intolerant species.

Alternative 3 prohibits the building of new roads in the WW management area and emphasizes unmanaged, mature hardwood, which would require fewer roads than the management activities possible under Alternative 2. Alternatives 1,2 and 4 would result in the potential construction and maintenance of more roads than under Alternative 3. Fewer roads would result in potentially less adverse, direct and indirect effects on soil and water resources.

3. Recreational Use of Trails and Roads

a. Equestrian Use

i. Soils

The recreational use of native-surface trails and roads by hikers, bicyclists, equestrians and other users can remove protective duff layers, displace topsoil, compact soil, cause ruts and braid the trail or road. Compaction increases bulk density and runoff and decreases infiltration. These effects increase soil erosion rates. Rainfall impact breaks loose displaced soil particles that become suspended in surface runoff and carried away. Eroded soil particles may be re-deposited along the trail or in nearby streams.

Different types of recreational use cause different levels of effects on native-surface trails and roads. Wilson and Seney (1994) conducted a study comparing the effects of different user-groups and found that equestrian use caused more soil compaction and erosion than other users, such as hikers, motorcyclists and mountain bikers. Dale and Weaver (1978) conducted a study of the trampling effects of hikers, motorcycles and horses in meadows and forestland near Bridger Range, Montana. They found that trail width increased as use increased. Trail depth increased, with up to 1,000 passes, and tended to be greater on slopes than on level sites and greater in a stone-free meadow soil than in a stony, forest soil, at least for hikers and bicyclists. Trail depth was greatest under equestrian use and least under hiker use at all sites, which could be due to a combination of compaction and erosion.

Soil quality is compromised by trail use. Removal of the duff-layer and subsequent compaction and erosion will diminish soil productivity. However, this is over the localized area of the trail-tread itself that, in the case of non-system routes, is two to four feet wide in most cases. System routes can be slightly wider. Compaction reduces soil productivity and infiltration and increases runoff and erosion. The loss of soil productivity in localized areas such as trail-treads, which account for a small percentage of the area, rarely affects site productivity as a whole. Under any alternative, site productivity would be protected;

however, restricting certain types of use in system trails will reduce unnecessary erosion and sedimentation.

All alternatives allow for equestrian use of a number of roads and trails. Alternative 3 envisions the least miles (about 450), Alternatives 2 and 4 the most (about 700), and Alternative 1 somewhere in between. More miles would result in greater potential for erosion and sedimentation; therefore, Alternative 3 would better protect the soil and water resources.

Under wet soil conditions, native-surface trails and roads are more vulnerable to rutting, compaction and erosion. Seasonal closures reduce the effects of horse-traffic by preventing equestrians from riding trails during the typically wettest period of the year and the freeze-thaw cycles. At different soil-moisture contents, soils have different load-bearing strengths. Dry, silt-loam–textured soils can support more weight than wet soils (Kuss, 1986). As the soil-water content increases, the soil becomes plastic and flexible. The addition of more water leads to liquid-soil behavior. Soils in a liquid state flow in response to pressure. For example, the pressure of a tire, boot or hoof causes the soil to flow up and around the object, causing a rut. Use during the period of time when the soil has decreased load-bearing ability would result in increased rutting and compaction, leading to increased erosion. Wilson and Seney (1994) conducted a study in Montana comparing the effects of different forest recreational trail users and found that the greatest sediment yields resulted from the use of wet trails.

Climatic events are unpredictable; wet conditions can happen throughout the year and, in some years, coincide with the period of highest use. Graveling the trail-tread would increase the wet-strength of the trail (Aust *et al.*, 2005 and Flerchinger and Watts, 1987) and improved drainage structures would channel water quickly from the trail-tread. Drainage and graveling would mitigate much of the increased rutting, compaction and erosion resulting from the use of wet trails. Although graveling would increase the strength, the maintenance needs of graveled trails used during wet conditions would likely be greater than that of graveled trails not ridden during wet conditions.

Seasonal closures under Alternatives 2 and 3 would reduce erosion, compaction and their associated effects on system roads and trails better than Alternatives 1 and 4, which allow for year-long riding. Use of drained, graveled trails and roads for recreational purposes would result in minimal soil erosion and sedimentation.

ii. Water Quality

Effects on water quality from recreational use are correlated to effects on soils. Erosion results in increased sedimentation into streams. In addition, at stream-crossings the streambanks can be disturbed and some aquatic habitat damaged.

Water quality can be affected when detached soil particles enter nearby streams through overland flow. Sediment that enters the stream-course can increase turbidity, reduce water-transparency and alter the nutrient-status of the streambed-composition (Waters, 1995). Where existing trails do not cross streams, banks are generally steep and erodible. Non-system crossings can cause banks to collapse into the stream across the trail-tread, adding sediment to the stream. If this occurs at the same location for a long period, most of the bank is removed across the trail-tread and streambank-slope is reduced. In addition, the potential exists for sedimentation and nutrient-enrichment of creeks, which negatively affects aquatic animal and plant life. Sedimentation increases turbidity, which makes it difficult for certain types of fish to feed and aquatic plant life to receive direct sunlight. Horse manure that is washed into streams and water-courses enriches them with nutrients. An increase in nutrients can cause an algal bloom in pools during low-flow periods. This changes water color and clarity and depletes oxygen from the water.

Because Alternative 1 does not restrict equestrian use to designated trails, except in natural areas, and offers an up-to-338-mile corridor for equestrian-hiker trails, it could result in adverse, direct and indirect effects greater than under any of the other alternatives. This is because cross-country riding and the use of user-developed trails would be allowed and there would likely be more use on these user-developed routes because there would be fewer miles of system trails than under Alternatives 2 and 4. Many portions of non-system trails are poorly located, increasing the potential for compaction, erosion and sedimentation. These non-system routes cannot be maintained, so braiding can occur when gullies or wet areas develop.

Alternatives 2 and 4 could establish up to 700 miles of designated hiker-equestrian trails and would restrict equestrian use to system trails throughout the Forest. System trails would be better-located and regularly maintained. Implementation of Alternative 2 would result in minimally adverse direct and indirect effects—greater than under Alternative 3, but less than Alternative 1, mainly because equestrians would be required to ride on system trails only.

Alternative 3 would allow the fewest miles of system trails—up to 450 miles, as well as restrict equestrians to system trails. Alternative 3 would also impose a winter-seasonal closure. This would help reduce compaction and erosion. The seasonal closure would coincide with the forest road-closure season that starts following the last shotgun deer season in early December and continues until the end of the spring turkey season in May. Implementation of Alternative 3 would result in minimally adverse direct and indirect effects—less than under any other alternative.

b. Off-Highway Vehicle Use

i. Soils

Off-highway vehicle-use—here focusing on ATV/OHM use—exposes bare soil, causes compaction and, consequently, increases soil erosion on native-surface trails and roads. A report entitled "Soil Resources on the Shawnee National Forest and Their Limitations for Off Road Vehicle Use" was published in 1974. That report describes the effects of four-wheel-drive jeep-style vehicle or pick-up use on soils and the period of the year when use is likely to cause the greatest damage; that is, the critical period when native-surface roads are wet and most vulnerable to rutting, gully formation, compaction and erosion.

Soil compaction, erosion, rutting and sedimentation are direct and indirect effects of ATV/OHM use. This can reduce soil infiltration and permeability. Vehicles with rubber tires cause soil compaction; but the soft, low-pressure tires found on ATVs cause less compaction and rutting than licensed vehicles (usually four-wheel-drive pick-ups), that have a much higher weight per tire-surface area than ATVs. Rutting in many cases leads to gully formation. Unauthorized cross-country riding up and down steep slopes or within stream-channels has the most effect on soil and water. Effects on soils can be mitigated by route design and location, hardening trails with gravel or other material, prohibiting use during wet periods or freeze-thaw cycles, installing drainage structures, restricting access and other actions.

ii. Water Quality

Effects on water quality from ATV/OHM use result from sediment eroded from the trails and roads. Sedimentation decreases water clarity (increases turbidity), making it difficult for some fish to feed and increasing water temperature. In addition, at stream-crossings the substrate is disturbed and some aquatic habitat is destroyed. Users that ride unauthorized off-road vehicles within stream-channels and along streambanks cause the most adverse effects on water quality. Driving or riding along streambanks or in streams increases turbidity and can damage aquatic habitat.

On the Ouachita National Forest, Arkansas, a study was completed that analyzed the effects of ATVs on streambed embeddedness, percentage of sands and fines, maximum stream pool-depth and pool-volume. Reference streams were compared to streams where extensive ATV use was occurring, Gap and Board Camp Creeks. Results indicated that embeddedness, percentage of sands and fines and pool-depth parameters had declined on Gap Creek and both Gap and Board Camp Creek have had significant declines in pool-volume as compared to reference streams. The decline in these parameters was caused by an increase in sedimentation caused by the old road system, ATV-use and associated activities (Clingenpeel, 1998). It is noted that, in these study areas, ATVs were allowed to ride off the designated trail system. They were riding up and down the streams as well as creating new non-system trails. The author acknowledges that the problem would be minimal if ATVs were restricted to designated trails.

Implementation of Alternative 1 would result in the direct and indirect effects of compaction, erosion, sedimentation and soil disturbance, more than Alternatives 2 and 3, but less than 4, which also proposes up to 286 miles of ATV/OHM travelways, but adds the designation of up to 50 percent of level 1 and 2 forest roads for seasonal ATV and OHM use. Alternative 1 establishes monitoring and enforcement standards and thresholds for effects on soils and other resources. If resource damage exceeded threshold-standards, trails could be closed, thus mitigating adverse effects to some degree.

Alternatives 2 and 3 prohibit ATV/OHM use on the Forest except for administrative purposes. Implementation of these alternatives would result in the least adverse direct and indirect effects of the alternatives. Alternative 4 allows ATV/OHM use on up to 286 miles of designated travelways (as under Alternative 1), as well as on up to 50 percent of level 1 and 2 roads. The travelways would consist predominantly of Forest Service roads; but, similar to Alternative 1, there could be 80 miles of new construction. The adverse direct and indirect effects of Alternatives 4 and 1 would be very similar since both propose about the same designated mileage for ATV and OHM use.

Alternative 1 would allow only licensed vehicles on all class 1 and 2 roads seasonally, while Alternative 4 would allow up to 50 percent of these roads to be designated as ATV/OHV travelways. The remaining class 1 and 2 roads would be designated for licensed vehicles only. Since ATVs travel less heavily on the land, substituting ATV use for licensed vehicle use would reduce adverse effects to some degree. Effects can be mitigated by route design and location, hardening trails with gravel or other material, prohibiting use during wet periods or freeze-thaw cycles, installing drainage structures and other actions.

4. Dispersed Recreational Use

a. Unauthorized ATV Use

Under any alternative, unauthorized ATV use can be expected to occur off designated roads and trails. Due to the fragmented nature of national forest ownership, there are many places from which to gain access to national forest land from private land. Off-road and off-trail ATV use causes greater adverse effects than operating on designated roads and trails. Unauthorized use can occur on steep slopes for operators looking for more challenge, or on streambanks and channel substrate not able to withstand this use. If bare soil is exposed by repeated riding on steep slopes, excessive erosion can occur. The riding of ATVs across a stream can lead to the collapse of banks into the stream, increasing sedimentation and turbidity. Because of the many roads and trails that require maintenance, it is unlikely that there would ever be enough resources to mitigate unauthorized use. Erosion and sedimentation would continue on steep slopes and along streambanks. Increased law enforcement and the levying of penalties would help reduce unauthorized ATV use.

b. Cross-Country Equestrian Use

Where cross-country riding is allowed, dispersed use can be heavy, and constant enough in some areas to cause the development of additional trails. These non-system trails can be poorly located up and down the slope and on streambanks, through wet areas and narrow passes. Researchers have noted that resource impacts from trail use on the Hoosier National Forest—with soils and topography similar to the SNF—are related more to the poor location of trails than to the type of or amount of use (Aust *et al*., 2005). Poor location increases the risk of erosion. Braiding occurs around wet areas and where gullies form on trails, increasing the area of disturbance.

Trail erosion can affect water quality when detached soil particles enter nearby streams through overland flow. Sediment that enters the stream-course can increase turbidity, reduce water transparency and alter the nutrient status of the streambed-composition. Non-system crossings can decrease bank stability, adding sediment to the stream. Sedimentation increases turbidity, making it difficult for some types of fish to feed and aquatic plants to receive direct sunlight.

c. Hiking and Rock-Climbing

These activities can cause compaction and expose bare soil that can lead to erosion. This is evident on many trails and at many of the small, concentrated-use areas scattered throughout the Forest. Under any alternative, no adverse effects on soil and water resources are expected to occur as a result of hiking or rock-climbing.

5. Developed Recreational Site Use

At developed recreational sites, under any alternative, Forest Service sanitary systems are connected to municipal systems or IEPA- and local health department-approved sanitation systems. The Golconda Job Corp Facility and Pounds Hollow Recreation Area have a National Permit Discharge Elimination System (NPDES) permit from the IEPA to operate a sand-filter system. Sealed vault toilets are used at campgrounds and recreation areas. Concessionaires are required to meet the same standards as the Forest Service and are required to obtain all permits from applicable public health or other state, county, or local agencies. No effects are anticipated under any alternative; however, Alternatives 1 and 3 allow no new sites, only the continued operation of existing sites. Alternatives 2 and 4 allow for closure of and development of new sites. All alternatives would protect soil and water resources.

6. Timber Harvest

Timber harvest and related activities can affect soil and water resources. Cutting trees causes little harm; however, the removal of harvested trees can cause adverse effects. Harvesting activities such as felling, skidding, and machine piling can result in detrimental soil compaction, puddling, displacement and erosion. Preventive and mitigating actions can reduce these effects.

When considering the potential effects of timber harvest activities on soils, the type of silvicultural system being proposed is important. Shelterwood, shelterwood with reserves, and group selection can each affect soils differently. In comparing effects, there are advantages and disadvantages to each system.

Potential differences arise among harvest techniques due to the frequency of use of skid-trails, log-landings and access roads. The access system is the major source of sediment in most forest streams. During each entry, there is repeated use of log-landings, temporary roads and skid-trails. This exposes bare soil and causes compaction, both of which can increase the potential for erosion and sedimentation. The more entries made on a given cutting-unit over a given period, the more potential effects on soil and water resources can be expected.

Within a watershed, effects on soil and water from a shelterwood-harvest entry should be less than under the clearcut method, because not all of the trees are removed at the same time. However, the two or three entries associated with the shelterwood method, requiring the repeated use of landings and transportation systems, would increase the potential for effects on soil and water quality over a 100-year rotation. Shelterwood harvest would have fewer effects on soil and water than would group selection, which requires up to four or more entries over a 100-year harvest-rotation. Shelterwood with reserves, which would leave 20 to 40 percent of the overstory indefinitely, would have one less entry than the standard shelterwood system and, thus, less effect on soil and water.

Pine plantations would be added to the suitable timber-base under Alternatives 2 and 4 and, even though they are not in the suitable timber-base under Alternative 1, shelterwood-with-reserves harvest of pine likely would be used for ecological restoration. Pine-harvest would have about the same effects on soil and water under Alternative 1, 2 or 4.

a. Erosion and Compaction

Most of the direct effects on soil and water are a result of the methods used to remove the cut tree-stems from the stand (Aubertin 1992). This includes the use of roads, skid-trails and log-landings. The appropriate layout and design of the logging system and skid-trails according to the suitability and limitations of the soil are important in order to reduce the potential for erosion and sedimentation. This includes careful construction of roads, skid-trails and log-landings, caution in wet weather and road closure when appropriate.

Some temporary compaction is expected on major skid-trails, roads and log-landings, and slight, temporary compaction is possible elsewhere in the cutting units (Vidrine *et al*., 1999). Forest-wide timber-sale monitoring indicates minor short-term soil exposure from harvest operations and minor soil displacement in the long term (USDA FS, 1999; USDA FS, 2000; USDA FS, 2001; USDA FS, 2002; USDA FS, 2003). Scattered areas of exposed soil from machines maneuvering on uneven ground typically re-vegetate naturally within one or two growing seasons and are not an erosion concern.

Where temporary roads and main skid-trails occur on short, steep slopes, water bars would be constructed to divert water from the exposed area. This would be effective because the less steep and shorter the slope, the less erosion is expected (Dissmeyer, 1984). Mulching and the establishment of vegetative cover are also very effective at controlling erosion (Brady, 1984). Once vegetation is established, it protects the soil by intercepting rainfall, depositing litter on the forest floor and developing root systems that hold the soil in place.

According to Patric (1995), forest soil and water quality are protected during and after a well-managed harvest. Studies throughout the eastern United States have shown the effects of timber harvest on soil erosion, compaction, and soil productivity:

- In a study located in north-central West Virginia, Kochenderfer and Helvey (1984) compared the effects of five different harvest treatments. They found that gravel application was successful in controlling erosion on roads, and that stem removal did not result in detrimental dissolved-nutrient losses.

- A study done in a Loblolly pine stand in the Atlantic coastal plain indicated that the compaction that will occur will be a temporary condition on the major skid-trails and log-landings (up to 18 years in the absence of mitigation) (Hatchell *et al*., 1970).

- The preliminary five-year results for several long-term site-productivity research plots in the South showed that compacted areas were loosened naturally within five percent of original bulk density after five years, and that site productivity was sustained (Scott *et al*., 2004).

- Several studies have shown that site productivity is maintained by controlling erosion and compaction using best-management practices and other mitigations similar to

Forest Plan standards and guidelines (Adams and Hook, 1993; Arthur, 1998; Aubertin, 1992; Lynch and Corbett, 1989; Pelren, 1991).

Prior to the implementation of any harvest activities, thorough site-specific analysis would be done to disclose the effects of proposed activities on soil and water resources. Incorporating the preventive or mitigating measures found in the Forest Plan (see section 2500 of the proposed Plan's Forest-wide standards and guidelines and Appendix F) would decrease the potential for erosion and sedimentation. The possible harvest activities could result in a temporary, minor increase in soil erosion, localized areas of temporarily compacted soil within the harvest units, and possible minor, localized areas of other detrimental soil conditions, such as rutting or soil displacement.

The direct and indirect effects from possible timber-harvest activities vary by alternative. Alternative 3 prohibits timber harvest, resulting in fewer disturbances, and a reduced potential for soil erosion and compaction. Alternative 2 potentially would result in a temporary, minor increase in soil erosion, localized areas of temporarily compacted soil, and possible minor, localized areas of other detrimental soil conditions, such as rutting or soil displacement within the harvest units. The effects of Alternative 4 would be less than Alternative 2 because it would allow fewer entries into the stands. Alternative 1 would result in fewer acres suitable for harvest, but potentially increased effects on soil and water resources, relative to Alternatives 2 and 4, due to the possibility of multiple entries.

b. Soil Productivity

The prevention and mitigation of erosion, compaction and other detrimental soil conditions (FSH 2509.18) are the main concerns for protecting soil productivity. This is because the majority of nutrients are in the soil, with the timber containing only a small percentage of the total nutrients in the forest. Compliance with the proposed Plan standards and guidelines would prevent or mitigate physical disturbances that could result in extensive detrimental soil conditions, thereby protecting soil resources.

Nutrients, such as nitrogen, calcium and potassium, are stored primarily in the mineral soil and litter, or O-horizon. Several studies in the Northeast, including the Hubbard Brook Experimental Forest, showed the results of a whole-tree clearcut treatment. This treatment resulted in a 4-6-percent loss of total nitrogen, a 5-13-percent loss of calcium and a 2-3-percent loss of potassium (Pierce *et al*., 1993). The calcium losses in these studies are higher than are anticipated on the Forest because the thin soils of the Northeast are vulnerable to leaching due to acid rain (Hornbeck and Kochenderfer, 2001). These figures represent losses from removal of all of the trees, much more material than would be removed under any of the treatments proposed under any alternative. Removing only the stems would leave on the site half of the nutrients in the trees (Pierce *et al*., 1993; Metz, 1965).

The Forest Service has established long-term research plots across the country to study the effects of timber-harvest activities on soil productivity. These studies focus on two key soil properties, organic matter and porosity. The ten-year results showed no evidence of impaired soil productivity after removing surface organic matter and compacting the soil. These are preliminary results from plots in the South and on the west coast. Results are not yet available from plots in the Midwest (Powers *et al*., 2004).

Limited disturbance and no removal of trees, as proposed under Alternative 3, would result in reduced potential for disturbance, resulting in a slight benefit because soil resources would be protected from a potential, temporary increase in erosion, compaction and other minor, localized areas of rutting or soil displacement. Alternatives 1, 2 and 4 would cause slightly different amounts of disturbance (from most to least), due primarily to frequency of entry. Although temporary, minor increases in soil erosion; localized areas of temporarily compacted soil; and possible minor, localized areas of other detrimental soil conditions, such as rutting, would be anticipated under the types of harvest proposed under the alternatives, implementation of Plan standards and guidelines and site-specific mitigation would prevent adverse effects on soil productivity.

c. Sedimentation and Hydrology

Surface debris, such as leaves, roots, and vegetation, would trap some of the eroded sediment, but some would be transported by runoff to nearby streams. Sediment that enters the stream-course can increase turbidity, reduce water-transparency and alter the nutrient-status of the streambed-composition (Waters, 1995). The potentially increased rate of erosion and sedimentation resulting from timber-harvest activities would likely last for three or more years and would be dependent on the time needed for revegetation to stabilize soil conditions (Kochenderfer *et al.*, 1997).

Cutting vegetation also temporarily decreases evaporation and transpiration, which can increase streamflow. Runoff generally increases following timber harvest (Pritchett, 1979) proportional to the acreage of timber harvested in relation to the size of the watershed. Site-specific analysis on a watershed basis will identify and mitigate any effects relative to alterations in streamflow. Revegetation, freezing and thawing and litter-fall soon return hydrology to pre-harvest conditions (Patric and Brink, 1976).
Studies throughout the eastern United States have shown the effects of timber harvest on nutrient concentrations, sediment and water yield:

- A study comparing a timber harvest with best-management practices compliance and one without compliance showed that best-management practices mitigated potential effects such that only minor changes in sediment yield and water temperature, all within background levels, were recorded (Kochenderfer and Hornbeck, 1999).

- According to Coweeta Hydrologic Laboratory research, cutting mixed hardwood forest in the southern Appalachians increases annual streamflow in proportion to the amount of vegetation removed. Clearcutting produces the maximum increases in streamflow, with less increase associated with selection cutting and shelterwood cuts. Additionally, streamflow tends to increase more on north-facing slopes and in areas where grass cover has replaced hardwoods (Douglass and Swank, 1972).

- In a study located in north-central West Virginia, Kochenderfer and Helvey (1984) compared the effects from five different harvest treatments. They found that if common sense and care are used in timber-harvest activities, sediment yield is only slightly higher than in undisturbed areas.

- A study done in the deep loess region of Mississippi showed that streamside best-management practices are effective at reducing sedimentation to low levels (Keim and Schoenholz, 1998).

- Studies have shown that harvesting vegetation temporarily reduces the demand for water and nutrients. This can result in an increase in nutrient runoff to streams in the short term. Natural systems are resilient, however, and this increase is usually short-lived and rarely affects water quality downstream (Swank, 1988).

The direct and indirect effects on water resources from possible timber-harvest activities vary by alternative. Alternative 3 prohibits timber harvest, resulting in fewer disturbances, reducing the potential for changes in streamflow and increased sedimentation. Possible harvests under Alternative 2 could potentially result in minor, temporary increases in streamflow and sediment yield in the affected watersheds. The effects of Alternative 4 would be less than Alternative 2 because it would result in fewer entries into the stands, resulting in less potential erosion and sedimentation. Alternative 1 would result in fewer acres suitable for harvest, but potentially increased effects on water resources, relative to Alternatives 2 and 4, due to multiple entries.

7. Vegetation Treatments

a. Timber-Stand Improvements

The effects on water and soil resources resulting from tree-planting, tree-cutting, thinning, mowing and timber-stand improvements would be minimal erosion and sedimentation under any of the alternatives. Most of the direct and indirect effects on soil and water are a result of the methods used to remove the cut tree-stems from the stand (Aubertin, 1992). If thinning should be done commercially, the effects would be similar to a commercial shelterwood entry, described above.

b. Pesticide Use

Under Alternative 1, 2 or 4, common forestry herbicides, such as glyphosate, triclopyr, dicamba, 2,4-D and others, could be applied to achieve vegetation-management objectives. These herbicides, at recommended rates, have no known adverse effects on the physical or chemical properties of soil. Effects on water quality in the short term would be minimal and, in the long term, water quality would be unaffected (USDA FS R8 EIS, 2003). The lowest effective application rate of these chemicals would not reduce the activity of soil biota and, although it could slightly increase the risk of nutrient leaching, mainly nitrogen, the primary benefit is the reduced risk of erosion. Herbicides are effective without disturbing the soil surface, which maintains soil-cover and low risk of erosion.

The programmatic effects of herbicide applications have been documented by the Southern Region of the Forest Service in EISs for vegetation management in the Appalachian Mountains, the Coastal Plain-Piedmont Region and the Ozark-Ouachita Mountains. Since these EISs address ecological regions on or similar to the Forest, and since the documented effects would be similar to effects on the Forest, these documents are incorporated here by reference. A number of specific mitigation measures for herbicide applications are listed in the records of decision to minimize adverse effects on the environment by protecting human health and safety; non-target vegetation; wildlife; threatened, endangered and sensitive species; soil, water and aquatic life; air quality; visual quality and cultural resources. These documents and mitigation measures will be utilized in the implementation of the Forest Plan to support site-specific analyses and minimize the effects of implementing specific vegetation-management treatments.

Alternatives 1, 2 and 4 would allow pesticide use, although use would be less restricted under Alternatives 2 and 4. Alternative 3 would not allow the use. All of these alternatives would protect soil and water resources; however, Alternatives 2 and 4 best protect the soil by providing an alternative method of vegetation management that would not disturb the soil.

8. Fire Management

a. Prescribed fire

i. Soil

Alternatives 1, 2 and 4 allow prescribed fire as a vegetation-management treatment; Alternative 3 would limit prescribed fire to natural areas. Prescribed fire and wildfire have the potential to temporarily accelerate erosion and sedimentation. Research has shown that prescribed fire has very few if any negative effects on the soil.

Forest-fire intensity and duration determines the effects on the physical, chemical and biological properties of soil. Vegetation-treatment prescriptions typically call for hot, rapid burns during periods of high soil-moisture in the spring or fall. This type of prescribed fire should have minimal effects on the soil (Wade and Lunsford, 1989). Prescribed fire on the Forest would generally be relatively cool, with no large areas of heavy fuel buildup. A portion of understory vegetation and forest floor would be consumed.

Prescribed fires seldom remove more than 50 percent of the surface organic layers and the soil fraction of the A-horizon is generally not affected by light burns. Observations on the Forest have shown that burned and unburned residue covers about 90-100 percent of the soil after a prescribed fire, leaving very little exposed (USDA Forest Service, 1996; USDA Forest Service, 1997; Kleinschmidt field notes, 2005). The potential for soil-surface erosion is low when the organic layer remains in place.

A fire-line about three feet wide and down to bare mineral soil may be needed to keep fire from spreading outside of prescribed areas. Vegetation would become established on these exposed areas, either naturally or with seeding, within one to two growing seasons, and would not be an erosion concern. Bulldozed lines up to eight feet in width could require waterbars to prevent erosion on steep slopes. Because low-intensity burns would not completely incinerate surface organic material, the potential would be minimal for increased erosion and alterations in nutrient cycling and soil properties.

ii. Soil Nutrients and Organic Matter

Forest Service prescribed burns are typically hot and rapid, during periods of high soil moisture. This type of burn would not substantially heat the soil and, therefore, would have minimal effect (Wade and Lunsford 1989; USDAFS, 1996; USDAFS, 1997). Monitoring conducted on the Forest has shown that soil temperature remained essentially unchanged from before the prescribed fire to immediately after the flame-front passed (USDAFS, 1997).

Several studies suggest that prescribed fire can slightly alter some of the chemical and biological conditions of a site. Periodic burning liberates nutrients bound in plant material and forest duff. These nutrients are then available for the establishment of new plant communities.

Several long-term studies of prescribed fire in the coastal plains found that low-intensity fires have no adverse effect on available phosphorous, calcium, or organic matter in surface mineral soil (McKee, 1982). Elliott and Vose (2005) studied the concentration of nitrate-nitrogen, ammonium-nitrogen, phosphate, sulfate, calcium, magnesium, potassium and pH in soil solution and streamwater after prescribed fire. They found no increase in these nutrients and no differences in total suspended solids in the streamwater between the burned and control plots. Knighton (1977) studied annual spring burns in the driftless area of Wisconsin. He found nitrogen, phosphorus, calcium, magnesium, and potassium increased slightly after burning, and nitrification increased in the weeks following a spring burn. Fire-dependent ecosystems and early-successional communities are often dominated by nitrogen-fixing species, such as native legumes, resulting in rapid replenishment of soil nitrogen (Van Lear and Waldrop, 1989).

Jorgensen and Wells (1971) suggest that prescribed fire improves site conditions, associated with an increased rate of fixation due to more available nutrients, higher soil moisture and temperature. Mineral elements such as potassium, calcium and magnesium are not volatilized by burning and remain in the ash. Phosphorus and sulfur are volatilized at higher temperatures than other nutrients and organic matter (775 degrees Celcius), so they are less susceptible to loss during burning (Hungerford, 1991).

DeSelm *et al.* (1990) conducted a study in Tennessee and found that, after 27 years of burning, the soil pH was slightly higher in the burn plot than in the control plot. This was attributed to the fire's liberation of exchangeable calcium, a basic cation. This increase would likely be undetectable in short-term management. Macronutrients such as potassium, calcium, phosphorus, sulfur and magnesium are not affected by low-intensity burning and remain on site in the ash and partially burned plant material (Van Lear and Waldrop, 1989; DeSelm *et al.*, 1990). A study done in an Appalachian pine stand showed that, after a low-intensity prescribed fire, the leaf litter was only partially consumed, with approximately two-thirds remaining (Swift *et al.*, 1992). When the soil moisture is high, the burn is likely to be incomplete, leaving much of the duff layer and not damaging the soil organic matter.

Light burning causes no detectable change in the total amount of organic matter in surface soils (Dyrness and Youngberg, 1957; Moehring *et al.*, 1966). Knoepp and Swank (1993) studied soil-nitrogen response in an Appalachian soil following site-preparation burning and found that, while prescribed fire increased available soil nitrogen, there was little change in nitrogen transformation rates or movement of dissolved inorganic nitrogen off site during the first year after burning.

iii. Soil Erosion

Fire-lines constructed with a bulldozer or fire-plow can expose bare soil. Bare-soil exposure leaves the soil vulnerable to rainfall impact and accelerated erosion. Best management practices, such as locating fire-lines on the contour as much as possible and installing water-control structures to shorten slope-length, would reduce the erosion potential. Fire-lines made with leaf-blowers or rakes leave the root-mat intact and do not require mitigation. Any increased potential for erosion is usually short-term, because fall leaf-drop and new spring growth provide protective soil-cover.

Researchers have studied the effects of prescribed fire and have found that low-intensity burns produce minimal soil erosion, even on relatively steep slopes (Van Lear and Waldrop, 1989). Research has also demonstrated that low-intensity prescribed fires have little, if any, adverse effect on soil characteristics (McKee, 1982). Cushwa *et al.* (1971) failed to detect significant soil-movement in established gullies following moderately intense backing-fires in mature loblolly pine-stands in the South Carolina Piedmont. Dobrowolski *et al.* (1992) studied the effects of long-term prescribed fire on infiltration and inter-rill erosion on sandy-loam and silt-loam soils in Louisiana. They found that biennial burning did not increase inter-rill erosion or reduce the infiltration capacities of these soils. In Appalachia, Swift *et al.* (1992) found that, following prescribed fire, humus and charred leaf-litter remained on most of the surface after burning. Evidence of soil-erosion was spotty and related to points of local disturbance.

iv. Water Quality

The effects of prescribed fire on water quality vary depending upon fire-intensity, type and amount of vegetation, ambient temperature, terrain and other factors. The major concern about fire's effects on water quality is the potential for increases in sedimentation (Tiedemann *et al.*, 1979). However, Brender and Cooper (1968) reported that repeated, low-intensity, prescribed fires have little effect on the hydrologic properties of soils; and Douglas and Van Lear (1983) determined that two, low-intensity burns had no significant effect on nutrient or sediment concentrations in ephemeral streams. The lack of significant effects on water quality in these studies is due to the low to moderate intensity of the prescribed burns. Even though terrain was relatively steep, sedimentation was not increased. Douglas and Goodwin (1980) demonstrated that this was because low- to moderate-intensity fires leave very little bare soil exposed and do not destroy the root-mat. Minor amounts of nutrients are expected to enter streams as a result of prescribed fires. Levels of phosphorus and nitrogen may increase slightly, but studies have found these increases to be small and within drinking-water standards (Dissmeyer, 2000).

When fire is prescribed and applied properly, water quality should not be adversely affected. Regardless of alternative and method of vegetation-management selected, negative effects on soil and water can be reduced by using specific burning techniques and by adhering to standards and guidelines. Project-level analysis of prescribed-burning proposals would specify site-specific mitigation measures to minimize adverse effects on the soil resource in the long term. There would be no adverse, direct or indirect soil-disturbance effects from the prescribed fire allowed under the alternatives in the short and long terms. The intensity and duration of prescribed burns would not be severe and, therefore, would not impair the physical, chemical or biological properties of soils. Alternatives 2 and 4 allow for more acres to be treated with prescribed fire than either Alternative 1 or 3. Alternative 3 would allow the least burning and, therefore, would result in less soil erosion and sedimentation than the other alternatives. Under any alternative, however, the result would be no adverse, direct or indirect effects on soil or water resources.

b. Wildfire

The effects of wildfires would be similar to those of prescribed fire, except that wildfires can be more intense and could expose more soil, leading to a greater potential for erosion and sedimentation. Wildfire suppression may call for emergency fire-line construction that could expose additional soil and increase the potential for erosion and sedimentation. All the alternatives address wildfire suppression, and there would be no difference in their effects on soil and water resources.

9. Integrated Pest Management

Most integrated pest management practices would likely deal with the control and/or eradication of non-native invasive species. Practices such as pulling, cutting or spot-burning would result in only minor soil disturbance and have little effect on soil and water resources. Tilling would reduce soil-cover and disturb the soil surface, leading to an increased potential for soil erosion and sedimentation. Application of herbicides would cause minimal soil disturbance. (The effects of prescribed fire are discussed above in section 8, immediately above, of tilling in section 10, immediately below, and of herbicide use in section 7.)

Alternative 1 proposes to focus management on parts of the Forest and Alternative 3 limits pest-control methods. Alternatives 2 and 4 would best protect soil and water resources in the long term by proposing to control pests throughout the Forest and allowing the use of pesticides. Early intervention and efficient, effective treatment options would best protect soil and water resources by limiting the area that could eventually require treatment.

10. Openings and Openlands Management

a. Wildlife Openings

Plowing, disking, bulldozing, mowing and planting are possible activities to manage openings under Alternative 1, 2 or 4. Site productivity and water quality could be affected by openings management due to soil erosion or compaction and the pollution of streams with sedimentation and fertilizers in runoff. Loss of fertilizers from the sites would be minimal because only necessary amounts of would be applied. Vegetated buffers would catch any minor amounts of runoff. Erosion and compaction are not likely because most sites are located on nearly level to gently sloping ridge-top sites, and management would be done while soils are not wet. Tillage would be infrequent; revegetation would occur within one season. Mowing would reduce woody and weedy competition and enhance herbaceous growth of food and nesting cultivars that would provide excellent erosion control.

Alternatives 1 and 4 allow the management of 1,630 openings, the maximum amount on the Forest. These alternatives would have more direct and indirect effects from openings management than Alternative 2, which proposes 500-700 openings, or Alternative 3, with no openings. These effects on soil and water would be minimal because the openings are small, well buffered by forestland and distributed over many watersheds. No adverse direct or indirect effects on soil and water resources are anticipated under any alternative.

b. Large Openlands

Openland management activities proposed under Alternatives 1, 2 and 4 include tillage, mowing, prescribed fire and fertilizer application. The effects of these actions are discussed above and below.

i. Soil

Tillage temporarily disturbs the soil in order to prepare a seedbed for the planting of grass, legumes or food crops. This temporary disturbance can create the potential for accelerated erosion until permanent vegetation is established. Proposed seeding would revegetate the areas quickly to control erosion (Brady, 1984)—normally in two to three months. Tillage likely would not be done annually on any specific location, which would also minimize erosion and compaction. Alternatives 1 and 4 would result in the greatest direct and indirect effects—albeit minimal—because all potential openlands could be managed.

Mowing openlands would reduce small, woody competition and enhance existing herbaceous understory, preventing the opportunity for erosion to occur. Mowing would have no adverse environmental effect regardless of location. Prescribed fire of openlands is allowed under Alternatives 1, 2 and 4. As discussed in section 8, above, prescribed fire of openlands would have minimal adverse effects on soil and water resources under any alternative.

ii. Water Quality

It is unlikely that detached soil particles or fertilizer runoff from openlands management would ever reach any stream-channel through overland flow. This is because tilled openings would be vegetated quickly and would be surrounded by vegetation that acts as a buffer. In addition, the small, scattered nature of the areas to be treated would limit the potential for water-quality problems to develop. Fertilizers and lime could be applied at recommended rates for maintaining vegetation. These amendments would be incorporated into the soil to ensure that they remain on site. Fertilizer and lime applied to existing vegetation would be trapped in the vegetation before attaching to soil particles and remain on the site.

Implementation of Alternatives 1, 2 and 4 would result in no adverse direct or indirect effects on soil and water resources. Alternative 3 proposes no openlands or openings management and, therefore, would have no effects on soil and water resources from this activity.

11. Aquatic Resources Management

Under any alternative, aquatic resource management activities, such as streambank stabilization and restoration, could have direct, adverse effects on water quality in the short term due to the turbidity created by soil-movement from the streambanks or bottom while activities are occurring. However, these activities would have, beneficial, indirect effects on soil and water resources in the long term. With the exception of pesticide use, discussed below, the effects of all the alternatives would be similar.

The use of rotenone, a pesticide allowed under Alternatives 1, 2 and 4, could have adverse, direct effects on water quality in the short term due to the brief presence of the chemical in the water and the presence of dead fish following application. Persistence of rotenone in water is highly temperature-dependent: if applied during the summer when water temperature is 23°C or greater, the half-life of rotenone is less than one day. The dead fish would decompose and be recycled as nutrients in the affected water body. The indirect effects of this activity would include more-balanced fisheries populations (Bettoli and Maceina, 1996). Alternative 3 would not allow the use of pesticides and, therefore, would not have any effects relate to the use of rotenone.

12. Minerals Management

Prior to the approval of any surface-disturbing mineral operation, a site-specific analysis would be conducted to determine the compatibility of proposed operations with the management prescription for the potentially affected area and, if compatible, to identify the necessary conditions of approval and mitigation measures designed to prevent or minimize any soil disturbance. The effects on soils would be identified during the site-specific analysis (Appendix H).

Because the Plan identifies the areas on the forest administratively available for oil and gas leasing, the following discussion of effects is limited to the possible effects of spills on Forest land if leased for oil and gas development and development were to take place.

a. Soil

Oil and gas operations may involve the removal of vegetation for well-pads, access roads and pipelines. Well-pads range in size from .5 acres to 5 acres. If productive, the well-pad area would be utilized for production equipment, such as tank batteries and the wellhead. Generally, only half or less of the site is needed for production equipment, with the remaining area reclaimed. Access roads would be maintained to Forest Service standards, unless the well is unproductive. If unproductive, the well-pad area and access roads would be reclaimed or maintained for other management activities. Pipeline rights-of-way generally are placed within existing rights-of-way and range from 10-30 feet in width. All rights-of-way are vegetated and maintained by the operator to prevent erosion.

The activities mentioned above associated with oil and gas operations, such as road and pad construction, can lead to compaction and bare-soil exposure, possibly resulting in decreased infiltration rates and the increased potential for run-off and erosion. Any Surface-Use Plan approved by the Forest Service must address soil disturbance by requiring applicable revegetation techniques that would include 1) the stockpiling of topsoil, 2) the harrowing and/or aeration of compacted surfaces, 3) the installation of water-bars or other water-control structures in areas from which precipitation can run off and 4) the completion of re-vegetation as soon as possible (Surface-Use Plan, Onshore Order 1 and Appendix H).

Spills

In the State of Illinois there are presently about 40,000 oil and gas wells, with 7,000 tank battery sites. Spill occurrences within the state over the last ten years have averaged about 175 annually. These occurrences may involve brine (water containing more dissolved inorganic salt than typical seawater) or oil, or both. In 2002, there was a total of 171 spills, with 64 involving oil and brine, 53 crude oil only, and 54 brine only. Fifty-two of the 171 spills occurred at tank battery sites and 119 from wells/flowlines. These resulted in the discharge of approximately 700 barrels of crude oil and 5,000 barrels of saltwater, the majority of which was recovered during clean-up operations (Larry Bengal, IDNR, personal communication). The recovery percentage of spills at tank batteries and well/flowlines is .7 percent and .3 percent, respectively.

The low occurrence of spills may be attributed to compliance with state and federal regulations and best management practices designed to prevent and mitigate accidental spills. These regulations and practices specify 1) berms around storage tanks, 2) regulated well-casing depths, 3) cementing and plugging standards, 4) blow-out preventers, 5) monitoring and inspection of pipe and flowlines and 6) use of liners in reserve pits. Alternatives 1 and 2 would provide conditions of approval that address site–specific mitigation measures (Appendix H).

The Oil Pollution Act of 1980 addresses guidelines for clean-up and resource damage assessment. There are many state and federal standards regarding spills. Oil and gas leases issued by the BLM are subject to Notice to Lessees-3A (NTL-3A), Reporting of Undesirable Events, which states that if a spill were to occur, any and all spills or leakages of oil, gas, saltwater, toxic liquids or waste materials, blowouts, fires, personal injuries, and fatalities shall be reported by the operator to the BLM and the surface-management agency, in accordance with the notice and any applicable local requirements. The BLM requires immediate reporting of all Class I occurrences (more than 100 barrels of fluid/500 MCF of gas released, any quantity that affects live water, or fatalities involved). In addition, operators must take immediate action to prevent and control spills and BLM, the surface-management agency, and other applicable regulatory authorities, must be consulted prior to treating or disposing of wastes and spills.

Brine

Brine is found at depths below the surface in porous rock units. Brine spills may occur from 1) a well blowout, 2) leaking storage tanks 3) production flow-lines or 4) inadequate well casing. If brine is inadvertently released in the soils, the salinity may reduce the soil productivity. Saline concentrations will determine the intensity and length of soil non-productivity; however, soils can be treated with buffering agents and fertilizer to mitigate these effects. Dilution from rain would also help to lower the concentrations and increase the soil productivity. The management of oil-brine-damaged areas is difficult, as the concentration of salts is highly variable and unpredictable (McCauley, Doolittle and Indorante, 1998).

Oil

Crude oil is a naturally occurring hydrocarbon. Hydrocarbons are chemical compounds composed of the elements hydrogen and carbon. The severity of an oil spill depends on a variety of factors, from the properties of the oil to the sensitivities of affected habitats. In soil habitats, the most defining factor would be the physical properties of the oil. The physical and chemical properties determine the manner in which the oil will spread and break down. These properties include surface tension, specific gravity and viscosity. Surface tension is the measure of the attraction between the surface molecules of a liquid. The higher the tension, the more likely the oil will remain in place. Higher temperatures reduce surface tension, increasing the spread of the oil. Specific gravity is the density of a substance compared to water. Generally, most oils are lighter than water; however, evaporation of lighter elements may increase the specific gravity, causing it to adhere to rocks or sink in water bodies. Viscosity is the measure of a fluid's resistance to flow. The higher the viscosity of the oil, the greater is the tendency for it to stay in one place. If the oil is highly viscous and does not penetrate the soil, it may be physically removed and trucked to an acceptable facility.

When oil is spilled, natural actions, such as weathering, evaporation, oxidation, biodegradation and emulsification can reduce severity and accelerate the recovery of the affected area. Evaporation occurs when the lighter or more volatile substances within the hydrocarbons become vapors and leave the surface. This process leaves the heavier components behind, to be physically removed. If the oil penetrates the soil, the predominant natural action is biodegradation. This natural process occurs very slowly in which bacteria and other microorganisms in the soil environment break down oil into harmless small molecules. Bioremediation is the practice whereby this process may be accelerated by adding nutrients, such as phosphates and nitrogen, to the soil in the area of the spill. This ensures an increase in the production rate of the microorganisms, leading to an increase in the natural process of oil breakdown. Additional bacteria may also be added to accelerate the bioremedial process. In addition to bioremediation, other clean-up measures include treatment with chemicals, containment of oil with physical barriers, and pumping the collected oil away from the site into storage tanks.

b. Water Quality

Site-specific effects on water quality are correlative. Erosion causes increased turbidity, as does the construction of stream-crossings (access ways and utility lines); release of drilling fluids, though most are non-toxic, can increase turbidity as well. Release of any toxic substance, a drilling additive or fluid produced from the well, could have an immediate, deleterious effect on water quality, generally not permanent. As discussed previously, a leaking well-casing or an improperly constructed reserve pit can pollute groundwater. Both state and federal regulations with regard to casing integrity require regular testing to detect leaks.

i. Oil Spills

Oil can interact with the sediment at the bottom of a stream, affecting organisms that live in or feed on sediments (EPA, 1999). This could also affect the habitats of fish and macroinvertebrates. The effects of an oil spill would correlate to the quantity of oil spilled and the proximity to an intermittent or perennial stream. Clean-up of oil spills is generally initiated within 24 hours from the report (Oil Pollution Act of 1980). While there may be an adverse effect in the short term, remediation is designed to return the area to its pre-spill condition.

Under Alternative 1, the Regional Forester would give consent to lease federal minerals for oil and gas. Leases would be subject to standard lease terms, controlled use stipulations and/or no surface-occupancy. All operations would be subject to the lease terms and conditions of approval of the Surface-Use Plan (Application for Permit to Drill). These terms and conditions would aid in the prevention and mitigation of brine and/or oil spills on Forest Service lands. If brine and/or oil are spilled from adjacent lands or from private oil/gas operations, the effects would be the same or increased due to possibly less restrictive standards.

Under Alternative 2, the Regional Forester would identify the SNF mineral lands available to lease for oil and gas, with Standard Lease Terms, controlled surface use stipulations or no surface-occupancy stipulations. No consent-to-lease decision would be made. Leasing would be considered if the Forest receives an expression of interest from industry or the BLM. All operations would be subject to the lease terms and conditions of approval of the Surface-Use Plan (Application for Permit to Drill). These terms and conditions would aid in the prevention and mitigation of brine/oil spills on Forest Service lands.

Under Alternative 3, all lands would be identified as unavailable for oil/gas leasing. No leases would be granted for oil/gas exploration. Federal oil and gas could be drained by adjacent operations, resulting in a loss of revenue and federal property. Under Alternative 4, all oil/gas leases would be subject to a no surface-occupancy lease stipulation. This would prevent industry from drilling directly on Forest Service lands, but would not prevent the potential for spills from pipelines traversing Forest lands or from private or adjacent oil/gas operations. Leasing interest may be deterred due to the high restrictions, which may make drilling costs uneconomical

13. Land-Ownership Adjustment

Although some newly acquired land could have erosion problems requiring management attention, beneficial direct and indirect effects generally are anticipated under any alternative when newly acquired land enters management under the revised Forest Plan standards and guidelines.

CUMULATIVE EFFECTS ON SOIL AND WATER

This discussion of cumulative effects takes into consideration the effects of the past, present and reasonably foreseeable future actions specified within the analysis boundaries at the beginning of Chapter 3, particularly the actions discussed below.

Past and present activities that are occurring, or have occurred, within the boundary of the analysis have resulted in the existing soil and water conditions. The activities in a watershed affect the quality of water in that watershed. For example, acidic mine drainage in Sugar Creek adversely affects water resources for many miles downstream and non-point sources of sediment throughout a watershed contribute to the collective sediment-load in a given stream. In general, the following major categories of activities have occurred, are presently occurring, or will likely occur on public and private lands within the analysis boundary.

- Agriculture: Agriculture is a past, present and future action in all of the watersheds to varying degrees. The amount of agriculture is expected to remain stable throughout this planning period. Agriculture has resulted, and will continue to result in, erosion of topsoil and input of sediment and small amounts of fertilizers and herbicides to adjacent waterbodies.

- Timber harvest: Limited timber harvest has occurred on the Forest within the analysis period; however, harvest activities have continued on private lands. In general, timber harvest results in a minor, temporary increase in soil erosion and compaction, and a minor, temporary increase in the quantity of sediment (three or more years) delivered to nearby streams (Kochenderfer *et al.*, 1997).

- Mining: Lands that have been mined in the past, or are currently being mined, are primarily in the northeastern, central and southwestern portions of the Forest. The effects vary greatly. If there is acidic mine drainage, or subsidence, the effects can be significant, but other mines have essentially stabilized except for minor amounts of erosion and sedimentation.

- Road construction and use: The road system in the planning area is maintained primarily by the Forest Service and by the county highway departments. The amount and type of maintenance planned for the next three years is similar to that of the past three years. Many low-level (1 and 2) roads are not maintained. Some of these non-maintained road segments are overgrown and unused, some are occasionally used but still relatively stable, and some are badly eroded. Road maintenance performed with heavy equipment can cause increases in erosion and sedimentation in the short term (one to two years), but results in a reduction over the lifetime of the road. Activities such as grading, graveling and out-sloping maintain the drainage, which reduces the amount of sediment eroded from the roadbed and, subsequently, the amount of sediment delivered to adjacent streams. Although regular road maintenance reduces the potential for erosion and sedimentation, graveled and native-surface roads are still a major source of sediment in most forested watersheds (Clinton and Vose, 2003). The existing road system and past and future maintenance on portions of these roads are expected to continue to contribute sediment to the streams in the planning area at a similar rate as in the past.

- Prescribed fire: The prescribed fires implemented in the past were typically moderate-intensity fires ignited during periods of high soil-moisture. This type of fire is planned for the future and can reduce groundcover temporarily (typically less than one year) within the burn-unit and expose bare soil along the fire-lines (about one to two years). This disturbance typically results in a slight increase in erosion-potential in the short term (one to two years) due to the reduced cover (Wade and Lunsford, 1989). Minor amounts of nutrients are expected to enter streams as a result of these projects. Levels of phosphorus and nitrogen may increase slightly, but studies have found these increases to be small and within drinking-water standards (Dissmeyer, 2000).

- Recreation: Past recreational activities included hiking, horseback riding, biking, rock-climbing, hunting, authorized and unauthorized ATV use and unauthorized off-highway vehicle use. These activities can cause compaction and expose bare soil, which is evident on many trails and at many of the small, concentrated-use areas scattered throughout the Forest.

- Residential development: Commercial, residential and other community developments reduce the productive land-base by occupying space, and can alter hydrology by increasing runoff from the increased, impermeable surface area. The amount of developed area in the analysis boundary is minor and is projected to remain stable throughout the planning period.

- Hydrologic modification: Dams and levees modify natural, hydrologic conditions throughout the Forest. Levees are located primarily along the Mississippi River, and dams have been constructed to make the major lakes and ponds on the Forest. These past actions will continue to affect hydrology in the future, along with a potential 1,172-acre reservoir on Sugar Creek near Creal Springs, Illinois.

Other past activities that have contributed to the effects on soil and water quality include grazing, powerline construction and maintenance, user-developed equestrian and hiker trails and increased equestrian use over the last ten years. Past activities that have had a positive effect on soil by controlling and reducing erosion and sedimentation include the filling of abandoned wells and cisterns, management of natural areas and wilderness areas, pine and hardwood plantation establishment, wetland restoration and road and trail maintenance.

1. Soil

a. Alternative 1

The potential for affecting soil quality is greatest under Alternative 1. This alternative is essentially the status quo, and the Forest has been managed under this Plan for the last 15 years. During that time, the Forest harvested timber, managed with prescribed fire, and experienced a variety of different recreational uses and pressures. No surface-occupancy associated with mining occurred during this planning period. Under the 1992 Plan, some unnecessary soil erosion occurred; but, overall, the Forest was successful in maintaining soil quality and conserving soil resources (USDA FS, 1999-2002). The incremental effects of Alternative 1, considered together with the effects of past, present and reasonably foreseeable future actions in the 25 watersheds that drain the Forest, would potentially result in adverse, cumulative effects of minimal extent on soil resources in some of the watersheds.

b. Alternative 2

Alternative 2 includes additional protection of riparian filter strips and public water-supply watersheds. It also allows for better soil-resource conservation in light of increasing recreational pressures. The effects of mineral management would be similar to those under Alternative 1, while timber harvests would primarily utilize reduced-impact techniques that have less potential effects on soil resources than those under Alternative 1. Treatment with prescribed fire would increase, compared to Alternative 1, but the potential for adverse effects on soils from this management remains remote.

Implementation of Alternative 2 would result in greater effects on soils than Alternative 3, but lesser effects than Alternatives 1 and 4. However, the incremental effects of Alternative 2, considered together with the effects of past, present and reasonably foreseeable future actions in the 25 watersheds that drain the Forest, would potentially result in minimal, adverse, cumulative effects of minor extent on soil resources in some of the watersheds.

c. Alternative 3

Implementation of Alternative 3 would have the least potential of any of the alternatives for adversely affecting soil quality. This alternative provides riparian and public water-supply protection similar to Alternatives 2 and 4, but better protects soil resources by restricting soil-disturbing activities, such as timber harvest and recreational use. It provides for limited use of prescribed fire and prohibits surface-occupancy for minerals management. The incremental effects of Alternative 3, considered together with the effects of past, present and reasonably foreseeable future actions in the 25 watersheds that drain the Forest, should result in minimal to no adverse, cumulative effects on soils.

d. Alternative 4

Implementation of Alternative 4 would have a greater potential to adversely affect soil quality than Alternative 3, slightly less than Alternative 1, and similar to Alternative 2. This alternative provides similar riparian and public water-supply protection as Alternatives 2 and 3, and would primarily utilize reduced-impact timber-harvest techniques that have less potential effects on soil resources than Alternative 1. This alternative would be less restrictive of soil-disturbing recreational activities than Alternatives 2 and 3. Treatment with prescribed fire would be similar to Alternative 2, but the potential for adverse effects on soils remains remote. This alternative also protects soil resources through the prohibition of surface-occupancy for minerals management. The incremental effects of Alternative 4, considered together with the effects of past, present and reasonably foreseeable future actions in the 25 watersheds that drain the Forest, would potentially result in minimal, adverse, cumulative effects of minor extent on soil resources in some of the watersheds.

2. Water Quality

The effects on water quality are directly related to the effects on soil. The more surface area disturbed, the greater the effect on water quality. Land-management activities can create small disturbances in or near streams that can, cumulatively, throw the streams out of balance (Colburn, 1989). Except for Alternative 3, there would be some degree of timber harvest and other surface-disturbing management activities on the Forest. Without mitigation, the effects of these activities can combine with the increased runoff from privately owned lands caused by timber harvest or conversion of woodlands to agricultural fields, both of which reduce transpiration. When this occurs, channel erosion and degradation can accelerate beyond natural levels. These, in turn, can affect fish habitat, water uses and the visual appearance of water.

It has been reported that forestry practices on federally owned land, which are usually less intensive than on privately owned land, have minor overall effects on sediment yield (Maxwell and Neary, 1991). Forest Service activities are less intensive compared to major local land uses such as agriculture and mining and the Forest employs mitigating measures to minimize the effects on soil and water. According to the Illinois Water Quality Report for 2004, the IEPA has listed hydrologic modification, agriculture and resource extraction as the three major sources of stream-water impairment in southern Illinois watersheds.

The past activities noted above also have the potential to affect water quality as well. The sedimentation of streams is directly correlated with soil erosion, as soil erosion supplies sediments that enter streams through overland flow (runoff). This negatively affects water quality. However, not all sediments eroded from upland sites reach the streams. Sediments suspended in runoff can be trapped in forest vegetation and organic litter.

Past soil-disturbing activities have increased sedimentation (above geologic rates) and have had an adverse effect on water quality. Past activities that contributed to this effect include farming, grazing, land-clearing for agriculture, commercial and residential development and construction, timber harvest, road construction and use, powerline construction and maintenance, use of user-developed equestrian and hiker trails, unauthorized ATV use and mining.

Past activities that have had only very minor and short-lived effects on water quality are timber-stand improvements, including tree-thinning and the use of herbicides, wildfires and prescribed fire, fire suppression, recreational facility construction and maintenance, wildlife opening construction and maintenance, levee and railroad construction and maintenance, dispersed recreation, artifact-hunting and collection and pond and waterhole construction.

Past activities that have had a positive effect on water quality by controlling and reducing erosion and sedimentation include the filling of abandoned wells and cisterns, management of natural areas and wilderness areas, pine and hardwood plantation establishment, tree planting, wetland restoration and road and trail maintenance.

a. Alternative 1

The potential to affect water quality is greatest under Alternative 1. The incremental effects of Alternative 1, considered together with the effects of past, present and reasonably foreseeable future actions in the 25 watersheds that drain the Forest, would result in unnecessary soil erosion and sedimentation, and may result in minor, adverse, cumulative effects on water quality.

b. Alternative 2

Alternative 2 would have lesser effects on water quality than Alternatives 1 and 4 and more than Alternative 3. The incremental effects of Alternative 2, considered together with the effects of past, present and reasonably foreseeable future actions in the 25 watersheds that drain the Forest, should result in minimal to no measurable adverse cumulative effects on water quality.

c. Alternative 3

Alternative 3 would have the least effects on water quality because of the minimal level of activity allowed. The incremental effects of Alternative 3, considered together with the effects of past, present and reasonably foreseeable future actions in the 25 watersheds that drain the Forest, should result in no adverse cumulative effects on water quality.

d. Alternative 4

Alternative 4 would have fewer effects on water quality than Alternative 1, more than Alternative 3 and similar to Alternative 2. The incremental effects of Alternative 4, considered together with the effects of past, present and reasonably foreseeable future actions in the 25 watersheds that drain the Forest, should result in minimal, adverse, cumulative effects on water quality.

B. AIR

Federal law requires federal land managers to protect air, land and water from the effects of air pollutants originating from federal lands. Forest management must comply with applicable federal and state laws and regulations, including the Clean Air Act (as amended). The Illinois Environmental Protection Agency (IEPA) has been designated by the state to administer the Clean Air Act. The IEPA regulates six common air-pollutants identified in the Clean Air Act. These pollutants are ozone, particulate matter of 2.5 microns or less (PM2.5), carbon monoxide, nitrogen dioxide, sulfur dioxide and lead. The IEPA has a tool called the “Air Quality Index” that communicates current and predicted air quality based on all the major pollutants listed above, except lead.

The IEPA maintains air-quality monitoring sites throughout the state. Most are concentrated around the larger metropolitan areas of Chicago and St. Louis. The sites closest to the Forest are Carbondale in Jackson County and Dale in Hamilton County. According to the IEPA 2004 Illinois Annual Air Quality Report, air quality at these monitoring stations met all national air-quality standards related to particulate matter and ozone—the pollutants monitored. There have been no violations on the Forest of the national ambient air-quality standards for any pollutants. Air within the Forest meets the established ambient-air standards.

The EPA monitors air quality in adjacent states and has designated several areas in the Midwest that are in “non-attainment” of various air-quality standards. The PM2.5 non-attainment areas nearest to the Forest are in four counties in Illinois—Madison, Monroe, St. Clair and one township in Randolph (near St. Louis). Ozone non-attainment areas nearest to the Forest include Madison, Monroe, St. Clair and Jersey Counties (near St. Louis).

Prior to each burning season, a permit would be obtained from the IEPA. All areas that are planned for burning are included in the annual burning permit from the state. In addition to the state permit, burn plans are written to comply with Forest Service regulations. The permit and the burn plan would require appropriate actions to ensure that smoke is dispersed in a safe manner and with low emissions. It is unlikely that present or proposed future Forest activities could contribute to conditions leading to non-attainment. It is also unlikely that any of the currently identified non-attainment areas could affect forest management or resources.

DIRECT AND INDIRECT EFFECTS ON AIR

The spatial boundary of the analysis of effects on air quality extends about 200 kilometers from the Forest boundary. This distance was chosen because present technology allows effects from only the very largest sources to be modeled accurately beyond about 200 kilometers. Under any of the alternatives, the implementation of most management activities could include the use of heavy equipment. Air quality can be locally (depending on winds) and temporarily affected by emissions from heavy equipment, including skid steers, tractors, dozers, skidders, trucks, etc. In general, the effects of these activities on air quality are expected to be minimal to non-existent. The effects of fire management and minerals management are discussed below. Existing air quality is a function of the air pollution resulting from past and present actions.

1. Fire Management

Prescribed Fire

Prescribed fire is the principal management activity on the Forest that can affect local and regional air quality; however, the current National Fire Plan and the Healthy Forest Initiative both direct the Forest Service to utilize prescribed fire more frequently. Despite potential air-quality effects, prescribed fire can provide important and necessary ecological benefits in forested landscapes. EPA has recognized these ecological benefits and developed the Interim Air Quality Policy on Wildland and Prescribed Fires (EPA, 1998). The major pollutant of concern in smoke is fine particulate matter, PM2.5. Studies indicate that 80 percent of all smoke particles emitted during wildland burning are less than 2.5 microns, or PM2.5 (Sandberg *et al*., 2002). These pollutants are of concern because they can affect human health. They also cause reduced visibility and serve as sorption for harmful gases.

Certain volatile organic compounds (VOCs) sometimes found in smoke may be important to human health and the aldehydes may be most important. Of these, formaldehyde has been extensively studied. It is known to cause cancer in laboratory animals and is regulated as a human carcinogen. However, using maximum assumptions of emission and exposure, it seems clear that exposure to smoke from prescribed burns does not represent a significant VOC-related carcinogenic risk. Respiratory irritation and allergic responses are the most important short-term consequences of smoke exposure (Sandberg and Dost 1990).

Carbon monoxide is a poisonous gas that might reach toxic levels above and adjacent to prescribed fires, but these high concentrations decline rapidly with increases in distance from the flame. Nitrogen oxides are not likely to be released in significant amounts during prescribed fire because the threshold temperature necessary for their release—1500 degrees Celsius—is hotter than temperatures normally occurring during prescribed fire (McMahon and Ryan 1976).

Prescribed fire is an essential forest-management tool; but, because it can have serious effects on air quality, smoke-management guidelines have been developed by the Forest Service to reduce the atmospheric impacts of prescribed fire. This system consists of five steps: (1) plotting the trajectory of the smoke; (2) identifying smoke-sensitive areas such as highways, airports, hospitals or schools; (3) identifying critical targets, i.e., targets close to the burn or those that already have an air-pollution problem; (4) determining the fuel-type to be burned, e.g., whether the fuel-load is light, as with a mature pine-stand with a grass understory, or heavy, as with the logging slash following clearcutting; (5) minimizing risk by burning under atmospheric conditions that hasten smoke dispersion, or by using appropriate firing techniques and timing to reduce smoke pollution (Van Lear and Waldrop 1989).

Forest-prescribed fire plans include smoke-management requirements that provide for smoke-dissipation to meet state and federal air-quality standards. For these reasons, the effects on local, regional or global air quality from the prescribed fire proposed in each of the alternatives would be virtually undetectable.

2. Minerals Management

Oil and Gas

Air quality can be locally (depending on winds) and temporarily affected by emissions from the heavy equipment used during road construction, drill-pad construction and drilling (about the same as several city buses). Encountering hydrogen sulfide (H_2S) gas is possible during oil/gas exploration; blowout preventers are standard equipment and gas detectors are required if the presence of H_2S is suspected (refer to BLM onshore order #6 and COA #62, Appendix H). In the Illinois Basin, H_2S is very uncommon, but has been found in low amounts during the secondary recovery of mature, extensively developed oil-fields (Illinois Department of Mines and Minerals and Bureau of Land Management records).

Under any alternative, the effects would depend on the potential for H_2S and the amount of drilling occurring on or adjacent to Forest land. All drilling operations on the Forest, as defined in the Surface-Use Plan (APD), would be subject to a site-specific analysis. During the analysis, the potential for H_2S would be evaluated by the BLM, and proper precautions and mitigation measures would apply.

There has been no exploration activity on the Forest during the life of the current Plan and, although the potential exists for an increase in activity, it is anticipated that the effects on local, regional, or global air quality from the possible future oil and gas activities proposed under each of the alternatives would be minimal to non-existent.

CUMULATIVE EFFECTS ON AIR

This discussion of cumulative effects takes into consideration the past, present and reasonably foreseeable future actions, specified at the beginning of Chapter 3. Past and present activities that are occurring, or have occurred, within the boundary of the analysis have resulted in the existing air-quality conditions. Trends in the levels of major pollutants have decreased throughout the years since the 1970’s, and continued efforts to reduce pollutant levels will likely further improve air quality in coming years (USEPA, 2003).

Although trends indicate better and better air quality, there remain places, primarily urban areas, where some sensitive people can be harmed by unhealthy air.

The Forest is located near the industrial heart of the United States. Operation of coal-fired electrical power-production plants is a past, present and reasonably foreseeable future action in the analysis area. Although improvements have been made, these activities have emitted, and will continue to emit, air pollutants in the vicinity of the Forest.

The emissions that could result from potential management actions in the Forest Plan, primarily fire management, would have a transient effect on air quality. Through site-specific consideration of the cumulative effects of specific projects, any possible adverse effects on sensitive populations would be mitigated through avoidance.

The nature, amount and persistence of emissions anticipated from possible management or use actions would be an overall, minor contribution to existing levels of air pollutants. Mitigation measures determined through site-specific analysis will adequately protect air quality. Considering past, present and reasonably foreseeable future actions, and in light of the fact that the effects on local, regional or global air quality from activities proposed under each of the alternatives would be virtually undetectable, no cumulative effects are anticipated. The implementation of any alternative would protect air quality.

C. FOREST ECOSYSTEM HEALTH AND SUSTAINABILITY

There are many views of what constitutes a healthy forest. To some observers, dead, dying and down trees are evidence of poor forest health, while others view them as evidence of cyclical diversity. For purposes of this analysis, forest health includes factors such as age, structure, composition, vigor; damage from insects, pathogens and invasive species; and resilience to fire and other disturbance agents. Generally, a well-managed forest with a wide variety of species and age classes is a healthy forest that has fewer problems with native insect and pathogenic epidemics than an unhealthy one. Biodiversity is also an essential factor in forest health, and is discussed in Section D.

1. FOREST RESOURCE HISTORY

The historical forest conditions and disturbance regimes are presented in the *Hoosier-Shawnee Ecological Assessment* by Parker and Ruffner (2004) and by Fralish *et al.* (2002). Pre-European-settlement forests of southern Illinois were loosely characterized into four ecotones: 1) mesic oak-hickory, 2) mixed hardwoods, 3) lowland-depression forests and 4) floodplain forests. Isolated fragments of savanna and prairie were present across the upland, north-central portions of the region, the cretaceous hills and the hill prairies along the bluffs of the Mississippi River (Anderson and Anderson, 1975; Fralish *et al.*, 1999). Small, native populations of shortleaf pine occurred on extremely xeric uplands of the Ozark Hills (Davis and Ruffner, 2001). Mesophytic species, such as American beech and sugar maple, were restricted to the low and alluvial sites mainly in the Illinois Ozark Hills and, to a lesser extent, in the Lesser and Greater Shawnee Hills (Fralish *et al.*, 2002).

With the settlement of Illinois during the early 19th century, the demand for wood for housing, fuel and fence-posts dramatically increased (Rolfe, 1990). As sawmills were introduced into the area with the rapid increase in towns and villages, the harvest of timber for high-value products greatly accelerated. The practice of cutting only desirable high-value species, known as "high-grading," left residual stands of trees that were defective, cull, misshapen and generally of little economic value (Den Uyl, 1962; Westveld, 1949).

The differences in growth-rate, longevity and value contributed to the condition of the forest-cover as it is today. Stands clearcut in the late 1800's for fuelwood and other uses regenerated to a mixture of tree species that are essentially of the same age. Because it may require 40 years longer (or more) for slower-growing, shade-tolerant species to mature, compared to the intolerant species (Marquis *et al*., 1984), past harvests produced stands that were not only a mixture of species, but also a mixture of sizes. These are often mistaken for uneven-aged stands though they are, in fact, even-aged (Marquis and Johnson, 1989; Gibbs, 1963; Roach and Gingrich, 1968).

Harvest of Illinois forestlands increased until the turn of the century and then began a steady decline due to the history of poor management. Commercial forestlands in Illinois continued to undergo changes through the 20th century. Between 1962 and 1985 more than half of the state's bottomland hardwoods were eliminated, either through disease or conversion to other land uses (Rolfe, 1990). During this same period, the upland oak-hickory forest-type decreased by 12 percent and the maple-beech increased by over 1,130 percent (Hahn, 1987).

Using the 1998 forest inventory of Illinois (Haugen, 2003), the forest-cover of the SNF can be placed into four major groups: oak-hickory (68 percent), maple-beech (16 percent), pine (12 percent) and other hardwoods (4 percent). Following is a brief description of these major forest groupings.

a. Oak-Hickory

Within this broad grouping, there are several other forest-cover types listed as “oak.” Various oak and hickory species are also listed as components of many other forest-types (Eyre, 1980). This type is found on all terrains, from dry, rocky ridges to deep coves and bottoms. The great range of soils and topography on the Forest results in widely different species-composition. Typically, white, northern red, southern red and black oaks are found throughout the type. Other common oaks on drier sites are the post and blackjack, with minor occurrences of the scarlet. Hickories such as pignut, mockernut and shagbark are consistent but minor components. Other overstory species that may occur are sugar maple, yellow poplar and beech. Some of the understory woody species that may occur are flowering dogwood, sassafras, hophornbeam and serviceberry.

b. Maple-Beech

The Forest is at the juncture of three forest-cover-type regions. For this reason, the maple-beech type includes species normally found in the northern, central and southern forest regions, as described by Eyre (1980). These types occur on a variety of sites, including sheltered coves, moist but well-drained stream floodplains, and moist, lower and north-facing slopes. Typical species of these types are maples, yellow poplar, sweetgum, beech, basswood, and various oaks and hickories.

Maple and beech are part of the understory of many other forest-cover types. Because of their tolerance for shaded conditions and their longevity, the maple-beech type is rapidly expanding in Illinois; as overstory trees die or are cut down, maples and beeches in the understory grow in to fill the gaps (Ebinger, 1986). A notable phenomenon in many central, hardwood forests is an increase in the dominance of sugar maple during the last half-century (Schlesinger, 1989). In 1962, maple-beech composed only 2 percent of the timberland area; but, by 1985, this had increased to 26 percent (Raile and Leatherberry, 1988). In presettlement periods, mesophytic species such as American beech and sugar maple were restricted to the low and alluvial sites predominantly in the Illinois Ozark Hills and, to a lesser extent, in the Lesser and Greater Shawnee Hills (Fralish *et al.*, 2002). Beech and maple are expected to dominate these historical sites in the future.

c. Pine

This type includes shortleaf and loblolly pine as well as a minor amount of eastern white pine. Except for a few, scattered, remnant stands of native shortleaf pine on the bluffs overlooking the Mississippi River, all other pine has been planted and exists in almost pure stands, usually established in old farm-fields. Pine was planted primarily to recover lands deforested for farming and then abandoned. It is a pioneer species and, in the later stages of succession, it is slowly replaced with a variety of hardwood species, including oaks, hickories and gum (Baker and Balmer, 1983; Lawson and Kitchens, 1983).

d. Other Hardwoods

Within this broad grouping are a number of individual forest-cover types recognized by the Society of American Foresters. On the Forest, this group includes upland and bottomland hardwoods other than oak-hickory and maple-beech. Past cutting-practices have resulted in these types being composed of mostly low-value species (Westveld, 1949; Hosner, 1962). Some of the common species associated with this diverse group are yellow poplar, white and green ash, black cherry, sweetgum, river birch, sycamore, cottonwood and boxelder. The number of understory woody species is also very diverse.

2. FIRE HISTORY

The historic role of fire in the development and maintenance of oak forests has been well established across much of the eastern deciduous biome (Lorimer, 1985; Abrams, 1992; Brose *et al.*, 2001). While pre-settlement fire-history data are limited for southern Illinois, fire as a natural component of the ecosystem is widely accepted (Abrams, 1992; Fralish, 1997; Heikens and Robertson, 1995; Robertson and Heikiens, 1994; Ruffner *et al.*, 2002).

Fire-history studies for the Missouri Ozarks (Guyette and Cutter, 1991) indicate that fire-return intervals during periods of Native American settlement (1701-1820) were longer (averaging about 12 years) than those of the Euro-American settlement period (averaging about four years). While these data represent the fire history of only the southern Missouri Ozarks, most forest ecologists would agree with the assumption that similar relationships existed across southern Illinois (Fralish *et al.*, 2002). Similar fire occurrences have been noted for the central hardwood forests of southern Indiana as well (Olsen, 1996).

Long-term maintenance of oak across the Shawnee Hills was probably driven by recurring fire with a 15-to-25-year return-interval (Fralish, 1977). Prairie communities of southern Illinois were maintained historically by a combination of drought and recurring fire on a two-to-six-year return-interval. Evaluations of central-hardwood mixed-oak forests suggest that these forests burned with low intensities on a 0-to-35-year return-interval (Ruffner and Carver, Draft, 2004).

Native American settlements were distributed across the Ozark Hills and Shawnee Hills and, thus, forests of these provinces were probably influenced by both natives and Euro-American-settler burning (Fralish *et al.*, 2002). Archaeologists believe Woodland Indian cultures cleared forests with fire to create open areas for cultivation. By the time of European contact (1650), the anthropological landscape resembled a mosaic pattern of 1) croplands near settlements, 2) abandoned clearings with early successional taxa and 3) open forest-stands dominated by fire-adapted species such as oak, hickory and walnut (Chapman *et al.*, 1982; Delcourt, 1987; Delcourt *et al.*, 1998; Ruffner and Abrams, 2002).

Regional studies reporting fire histories from the Historic period indicate that fire-ignitions were high during this period due to farmers clearing underbrush from the forest (Miller 1920; Robertson and Heikens, 1994). Reports during the early 1900's noted that farmers annually burned forests to increase the regeneration of grasses and forbs, as well as to reduce the understory to facilitate hunting and travel (Miller, 1920). The forest could not be burned every year due to the lack of sufficient fuels; however, these early accounts record that some portions of the forests were affected by fires each year, but the woods were not completely burned (Robertson and Heikens, 1994).

Fire has played an important role in the development and maintenance of the oak-hickory forests of the area and continued to do so through the early part of the 20th century. Numerous laws and local bans on fire marked the beginning of major efforts to control wildfires. After wildfire controls were enacted, the effects of periodic fire in maintaining healthy forests were removed from the ecosystem. It is during this time that numerous authors suggest a growing shift in species-composition occurred across much of southern Illinois when fire-intolerant species such as sugar maple began to replace fire-adapted oak and hickory species (Fralish *et al.*, 2002).

Similar conclusions have been reached by others researching southern Illinois forests (Ruffner and Carver, Draft, 2004) who, in addition, have documented the beneficial effects of prescribed fire to foster oak regeneration and reduce competing mesophytic species in forestlands. They also note that the protection from disturbance is likely to hasten the transition of species and will likely result in the loss of biological diversity across the region (Parker and Ruffner, 2004).

The effects of fire on other components of southern Illinois ecosystems have been documented by several authors. The effects of fire in maintaining and perpetuating barrens communities where many threatened, endangered and sensitive species occur has been well documented by Anderson (1994), Anderson and Schwegman (1971) and others, as have the detrimental effects of fire-cessation on barrens species (Anderson, Schwegman and Anderson

2000). The use of prescribed fire to maintain unique vegetation and habitat-types in glades and oak savannas has also been noted by Parker and Ruffner (2004). The detrimental effects of the lack of fire on grassland-types and the populations of shortleaf pine have also been documented (Ruffner and Carver, Draft, 2004).

a. Wildland Fire

During the past ten years, the Forest has averaged about 21 fires per year, with an annual burned area of 284 acres. More than 99 percent of these fires were human-caused. The numbers of acres burned per year varies due to differences in weather, the number of ignitions, fuel-types and similar other variables. These differences are reflected in the information in Table 3-8**.**

Table 3-8. Wildland-fire occurrence (ten-year average) by size-class, 1993-2002.*

Number of Fires/Acres Burned by Year by Fire-Size Class						
	A	B	C	D	E	Total
1993	0 / 0	2 / 4	1/ 23	0 / 0	0 / 0	3 / 27
1994	0 / 0	15 / 36	9 / 250	1 / 110	0 / 0	25 / 396
1995	3 / 1	16 / 55	14 / 470	2 / 347	0 / 0	35 / 873
1996	2 / 1	8 / 23	2 / 39	0 / 0	0 / 0	12 / 63
1997	3 / 1	4 / 11	0 / 0	0 / 0	0 / 0	7 / 12
1998	2 / 1	7 / 17	4 / 75	0 / 0	0 / 0	13 / 93
1999	9 / 6	10 / 31	7 / 159	0 / 0	0 / 0	26 / 196
2000	3 / <1	8 / 17	17 / 450	1 / 106	0 / 0	29 / 573
2001	7 / 1	11 / 45	15 / 467	0 / 0	0 / 0	33 / 513
2002	8 / 2	18 / 44	3 / 44	0 / 0	0 / 0	29 / 90

* Fire-size classes: A <.25 acre; B .25-10 acres; C 10-99 acres; D 100-300 acres; E 300-900 acres.

b. Fire Use and Forest Health and Sustainability

The oak-hickory forests of the eastern United States encompass over 114 million acres (Burns, 1983). Until the 1970's these oak-dominated forests had been considered a stable climax community (e.g., Braun, 1950; Weaver and Clements, 1938). Researchers and land managers, however, have been accumulating evidence over the past several decades that has led to a re-evaluation of the theory that oak-hickory forests are a stable, self-perpetuating ecosystem. Lorimer (1985), Schlesinger (1989), Schmelz *et al.* (1975) and Nigh *et al.* (1985) have documented the succession of oak-hickory forests to mixed-mesophytic forests dominated by hard maples, such as southern sugar maple (*Acer floridanum*), black maple (*A. nigrum*) and sugar maple (*A. saccharum*). In Illinois, Raile and Leatherberry (1988) and Hahn (1987) documented a decline of oak-hickory forest-types of 12 percent (275,500 acres) and an increase of maple-beech forest-types of 1,131 percent (961,400 acres) between 1962 and 1985.

Curtis (1959), Van Lear and Waldrop (1988) and Lorimer (1985) have stated that the decline in fire-frequencies and modern-day fire exclusions are primary factors in the replacement of oak-dominated forests by forests dominated by hard maples. In the cove forests of the western mesophytic forest (Braun 1950), red oak (*Quercus rubra*) and yellow poplar (*Liriodendron tulipifera*) are being replaced by hard maples due to a lack of periodic disturbance such as fire (Schlesinger, 1989; McGee 1986).

Maslen (1988), McGee (1979), Rouse (1986), Van Lear and Waldrop (1989) and Curtis (1959) have reviewed and documented the interrelationships between fire and the maintenance or decline of oak-dominated forests. Teuke and Van Lear (1982) reported that prescribed fire increased the percentage of oak in the advanced regeneration pool. The perpetuation of oak-dominated forest ecosystems was and is dependent upon the presence of adequate advanced oak-regeneration when tree-fall gaps occur (Sander, 1972). The exclusion of fire or other disturbances from mature oak-hickory forests has altered the ecology of these ecosystems, to the detriment of advanced oak regeneration (Van Lear and Johnson, 1983).

Periodic disturbances, such as prescribed fire, aid in the establishment of advanced regeneration in several ways. Johnson *et al.* (2002) noted that the presence of oak regeneration is usually required prior to stand-disturbance to produce a new generation of oak. Carvell and Tryon (1961) postulated that it is the degree and frequency of fire-disturbance that is most closely related to the amount of advanced oak-regeneration. In a study done by Merritt and Pope (1991), periodic prescribed fire increased the amount of ambient light in an oak-dominated forest and appeared to be one of the primary factors affecting oak-regeneration.

Godman, Yawney and Tubbs (1990) documented a reduction of sugar-maple seedling-survival in 55-percent-and-greater full sunlight. Oaks are categorized as either shade-intolerant or shade-intermediate (Burns and Honkala, 1990). Rouse (1986) stated that current oak-hickory forest-floor conditions are providing seedbeds more conducive to the germination and survival of shade-tolerant tree species. Zaczek *et al.* (2002) noted that the complete absence of fire allows non-fire–adapted species, including the dense sugar maple, to become established as advanced regeneration, or the fast-growing yellow-poplar to capture the site following disturbance; in either case the characteristically less-shade–tolerant and slower-growing oak seedlings are at a competitive disadvantage that is often insurmountable.

Periodic fire helps to provide a seedbed for the germination and successful establishment of oaks and hickories by reducing accumulated leaf-litter and minimizing woody encroachment caused by excessive shrubs and young trees. Acorn-germination occurs most successfully on mineral soil with a thin layer of leaf-litter (Sanders, 1977; Rogers, 1990).

Germinants of sugar maple are characterized by very vigorous, long radicles with sufficient strength to penetrate heavy leaf-litter and reach mineral soil (Godman, Yawney and Tubbs, 1990). Sugar-maple seed has an extremely high germination capacity, up to 95 percent or more; however, germination-rates are impaired and drop significantly as soil surface-temperatures exceed 50 degrees Fahrenheit. Seedbeds that have undergone a prescribed burn have higher-than-average soil surface-temperatures that can decrease or inhibit sugar-maple germination (Godman, Yawney and Tubbs, 1990).

The morphology of dead tree-leaves plays an important role in how an ecosystem responds to fire. Lorimer (1985) describes an example: sugar-maple leaves have a tendency to lie on the ground following the terrain's contour after a snowmelt or rain. This is due to the relative thinness and ready decomposability of the leaves. A fire in this scenario would be low and slow-spreading. Oak leaves, on the other hand, curl upon drying and ignite easily, carrying a fire at a relatively rapid rate. Lorimer suggests that the oak trees that retain some of their dead leaves through winter or early spring may be acting as storehouses of highly combustible fuels.

Wright (1986) postulated that the use of prescribed fire can reduce acorn-predation by some insect pests by either killing the pests directly, modifying their habitat by reducing leaf-litter depths, or removing breeding habitat. Galford, Peacock and Wright (1988) determined that the populations of certain beetle and acorn weevil-species that utilize germinating acorns were reduced on seedbeds that had been burned. Lorimer (1985) reported that fire had an indirect, beneficial effect by reducing rodent-predation upon acorns and oak-germinants. In particular, Lorimer stated that mice and voles preferred to forage in unburned areas rather than burned areas because the former, with litter-cover, offered more effective protection from predators.

Periodic fires enable oaks to become dominant among competing species, such as hard maples (Van Lear and Waldrop, 1989). Langdon (1981) found that oak seedlings are less susceptible to root-kill by fire than other species, thus giving oaks an ecological advantage. Oaks possess a thicker bark than other hardwood species, making them less susceptible to being top-killed by fire (Curtis, 1959; Lorimer, 1985; Van Lear and Waldrop, 1988; Van Lear and Watt, 1993; Harrod *et al.*, 2000). Oaks possess another ecological adaptation to a periodic-fire regime: most species will re-sprout vigorously from dormant buds at the base of the tree when the bole has been top-killed (Lorimer, 1985; Van Lear and Watt, 1993). Hard maples, by contrast, are susceptible to fire: thin-barked with seedlings that suffer high mortality due both to root-kill and top-kill.

Burning conditions and the size of understory vegetation can affect the response to fire. Franklin *et al.* (2003) found that burning did not affect stems greater than 1.5 inches in diameter at chest height. Species-specific anatomical differences related to re-sprouting are also important in allowing oaks and other fire-adapted species to show a favorable long-term response to prescribed fire. In oaks, thick bark, the ability to re-sprout repeatedly as well as to germinate in a burned seedbed and resistance to rotting due to scarring, are all adaptations to fire (Van Lear and Watt, 1993).

In ecosystems where periodic fire occurs, one of its direct effects is the destruction or disabling of allelopathic substances (which prevent other vegetation from growing up too closely to the source), thus allowing the regeneration of species that would otherwise be suppressed by these substances (Spurr and Barnes, 1980). Sugar maples release root-exudates that inhibit the regeneration of other plant species (Spurr and Barnes, 1980; Godman, Yawney and Tubbs, 1990). Asters (*Aster* spp.) and goldenrods (*Solidago* spp.) are common understory species of oak forests (Voigt and Mohlenbrock, 1964) and increase in abundance under periodic fire-disturbance regimes. They also exert allelopathic effects on the germination and development of sugar-maple seedlings (Godman *et al.*, 1990).

In summary, we know that fire is a key disturbance-factor related to the maintenance of oak-hickory ecosystems. Other factors, such as the management of overstory density and light conditions, as well as natural wind events that can also influence oak regeneration are discussed in the effects sections. As a component of these ecosystems, fire provides complex, ecological interactions that allow for successful regeneration of oak species.

c. Fire-Use Program

The Forest conducts an active prescribed-burning program, albeit limited in scope. Prescribed fire can be an effective management tool with a variety of applications and resource benefits, including wildlife-habitat improvement, ecological restoration, maintenance of fire-dependent plant communities, hazardous-fuels reduction and other management objectives. Table 3-9 shows the results of the past ten years' burning program on the Forest.

Lightning is not a prime cause of fires, but the chance of lightning-caused fires is present. Forest Service managers have the option of using lightning-caused fires for resource benefits as wildland-fire-use fires; but human-caused wildland fires must be suppressed. While in recent years the Forest has not had any large fires, such as typically occur on many Western forests, large fires are possible and probable on the Forest, given the proper combination of weather-conditions and fuels.

Table 3-9. Prescribed fire on the Forest, 1993-2002.

Year	Acres burned
1993	1,078
1994	721
1995	1,681
1996	175
1997	870
1998	259
1999	202
2000	207
2001	373
2002	432
Total Acres	5,998
Average per Year	600

As defined by the Forest Service (FSM 5105), prescribed fire is, "Any fire ignited by management actions to meet specific objectives. A written, approved prescribed-fire plan must exist and NEPA requirements must be met prior to ignition." Wildland-fire use is defined as, "The management of naturally ignited wildland fires to accomplish specific pre-stated resource-management objectives in predefined geographic areas as outlined in fire-management plans...." And fire use is defined as, "The combination of wildland-fire use and prescribed-fire application to meet resource objectives." It is important to understand these key differences in terminology in order to fully understand the range of options available for the skillful application of fire on the Forest landscape. While wildfires may not be managed to meet resource objectives, wildland-fire–use fires may be.

To date, prescribed fire is the only type of fire use implemented on the Forest. Although the probability of lightning-caused fires is remote (less than one percent), the opportunity to utilize lightning-caused ignitions to accomplish resource-management objectives remains an available tool that could be utilized in the management of the Forest under the proper conditions.

Prescribed fire and mechanical fuels-treatments are the primary methods used to restore areas on the Forest to within a historical range of fire-entry. 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). Fire-regime condition-classes (Schmidt *et al.*, 2002) are used by the federal land-management agencies as a qualitative measure to describe the degree of departure from historical fire-regimes, possibly resulting in alterations of key ecosystem components such as species-composition, structural stage, canopy-closure and fuel-loadings. The three classes are generally defined as follows:

i. Condition Class 1

Within the natural (historical) range of variability of vegetation-characteristics; fuel composition; fire frequency, severity and pattern; and other associated disturbances.

ii. Condition Class 2

Moderate departure from the natural (historical) range of variability of vegetation-characteristics; fuel composition; fire frequency, severity and pattern; and other associated disturbances.

iii. Condition Class 3

High departure from the natural (historical) range of variability of vegetation characteristics; fuel composition; fire frequency, severity and pattern; and other associated disturbances.

Most of the Forest is in Condition Class 2 or Condition Class 3 (Schmidt *et al.*, 2002; Ruffner and Carver, Draft, 2004).

3. INSECTS AND PATHOGENS

The Forest Service's Forest Health Protection Program summarizes the most up-to-date forest-insect and pathogenic conditions in the United States, including the Eastern and Southern Regions of the National Forest System (2005). Emerging hardwood pest problems for the Central Hardwood region and the Hoosier-Shawnee Ecological Assessment area are presented by Moltzan (2003) and Scarborough and Juzwik (2004). The activities of forest insects and pathogens are complex and varied and can have beneficial or adverse effects, depending on management objectives (Haack and Byler, 1993).

Insects and pathogens can have a strong influence on ecosystem health and sustainability. Many native species are present that can kill individual trees or, in some cases, kill large numbers of trees when certain pre-disposing conditions exist. Conditions conducive to destructive outbreaks of native insects and pathogens on the Forest would include prolonged drought, flooding, extensive areas of older mature trees and dense, highly competitive growing conditions. Slow growth and older age can be a stress factor (Wenger 1984), especially for tree species that tend to be shorter-lived. This includes scarlet, pin and black oaks. Tree species growing off-site can also become stressed and susceptible to insect and pathogen outbreaks (Stewart *et al*. 1984). This is most often encountered with plantations.

Native insects and pathogens that have caused mortality in the recent past and should be expected to kill trees in future years include southern pine beetle, forest tent caterpillar and a complex called “oak decline.” Oak decline involves a number of factors including age, environmental stress and several native insects and pathogens.

Exotic insects and pathogens can have the most devastating effects on forest ecosystem health and sustainability. Once established, they are difficult, if not impossible, to eradicate. It is important to identify potential exotic pests that may become established and try to prevent their initial introduction. Failing this, early detection and immediate action to attempt eradication is essential if there is any hope for success. Once established, active management is often the only tool available to minimize damage and maintain reduced levels of diversity and productivity.

The most threatening exotic insects and pathogens are not known to be on the Forest currently, though several are close and could easily be introduced at any time from something as simple as an infested piece of firewood. Asian long-horned beetle has been found in the Chicago area; emerald ash borer is present in very high numbers in and around southeast Michigan; and gypsy moth is advancing south from northern Illinois and northern Indiana. Sudden oak death has been reported on the west coast of the United States, but infested material has been distributed throughout the country on nursery stock and this deadly pathogen could appear in southern Illinois at any time.

Oak wilt is spreading in the central states and has been reported in most counties in southern Illinois, including those encompassing the Forest. The oak wilt fungus appears to be native to North America, although it acts very much like an introduced organism.

A short description of each of these problems follows.

a. Native Pests

i. Southern Pine Beetle

The southern pine beetle (*Dendroctonus frontalis* Z.) is the most destructive pine bark beetle in the southern United States. Pine trees are killed singly, in small groups, or over large areas, sometimes exceeding hundreds of acres. The beetle is a native pest in the south and occurs in small numbers (endemic) until outbreak or epidemic population-levels develop. Infestations can develop into outbreak levels when pine forests are stressed by crowded growing-conditions, trees are damaged from ice or wind or during drought, or when stands are considered biologically mature. These stress-conditions often prevent trees from producing adequate resin-flow to “pitch out” attacking insects, the tree’s main defense against attack.

Once pine-stands are weakened, they become more susceptible to attack by the southern pine beetle; and, once beetle populations develop in weakened trees, the beetles may spread to healthy trees that normally could resist attack. The Daniel Boone National Forest in Kentucky has had over 100,000 acres of pine-stands killed by southern pine beetle outbreaks. Although the SNF is located at the extreme northern edge of the southern pine beetles’ range, shortleaf and loblolly pine stands on the Forest could be susceptible to future attacks by the beetle due to their crowded, mature condition.

ii. Oak Decline

Oak decline is a debilitating progression of physical and biological stressors. Initially, environmental factors induce stress, followed by attack from various insects and pathogens. These may include the two-lined chestnut borer (*Agrilus bilineatus*), the red-oak borer (*Enaphalodes rufulus*), defoliators such as the European gypsy moth (*Lymantria dispar*) and fungi such as *Hypoxylon atropunctatum* and *Armillaria* species. Oak decline is currently affecting trees on the Mark Twain National Forest in Missouri and the Ozark and Ouachita National Forests in Arkansas.

Species in the red-oak group have been experiencing the greatest mortality in Missouri, Arkansas and Oklahoma on sites at high-risk for oak decline (Heitzman *et al*., 2004). As shown in Forest FIA plot data for the 1985, 1998 and 2003 inventories, mortality in the red oak group makes up 62-66 percent of the total oak-hickory mortality, and mortality in the oak and hickory groups comprises 63-75 percent of the total mortality that has been occurring on the Forest. However, this has not been linked with oak decline. The current management strategy is to harvest trees before physiological maturity.

iii. Forest Tent Caterpillar

Forest tent caterpillar (*Malacosoma disstria*) is a native caterpillar that has reached epidemic levels in the Oakwood Bottoms Greentree Reservoir and surrounding area during the late 1960's, mid-1980's and the late 1990's to 2002. Leaf-feeding occurs in early spring. During outbreaks, large expanses of trees can be completely defoliated. This stresses trees and can reduce growth and acorn production. Repeated outbreaks can lead to branch and tree mortality.

iv. Oak Wilt

Oak wilt is caused by the fungus *Ceratocystis fagacearum* Hunt. It has been found in 21 states, with considerable damage occurring in the Midwest. Oak wilt is common in northeastern Illinois, but it also occurs in the south-central portion of the state. All species of oak are susceptible, but members of the red-oak group will be killed within weeks of becoming infected. This disease is most serious in forests where red oaks are numerous. There is a high likelihood of root-grafting amongst red oaks and this is how the disease spreads locally. Disruption of root-grafts between healthy and diseased trees will contain the disease in established centers. Overland spread occurs when beetles carrying spores are attracted to wounds on oaks, thereby introducing the fungus at the wound site. This takes place most often in the spring and early summer. Preventing or immediately treating wounds is the key to preventing overland spread. Members of the white-oak group are susceptible but can take years to die once infected.

b. Non-native Pests

i. Gypsy Moth

The gypsy moth (*Lymantria dispar*) is a non-native invasive insect brought to the United States from France to start a silk industry and it was accidentally released in eastern Massachusetts in the late 1860's. Despite many early attempts to halt its spread, it has become permanently established in the United States. By 2004 it has become established in all or parts of 19 states and the District of Columbia. It continues to spread into un-infested areas and is a major defoliator of deciduous hardwood forests, with oak being the favored host.

There are three strategies available for management of the gypsy moth: eradication, slow-the-spread and suppression. The choice of a strategy is based on the population of gypsy moths in a geographic area. Eradication is used where gypsy moth is not permanently established. Slow-the-spread is used where gypsy moth is present at low population levels. Suppression is used where gypsy moth has become permanently established. The insect is present in northern Illinois, where the state is participating in the slow-the-spread program. The eradication strategy is being utilized in the remainder of the state.

ii. Asian Long-Horned Beetle

The Asian long-horned beetle (*Anoplophora glabripennis*) primarily attacks maple species by larval-tunneling that girdles tree stems and branches. Quarantines are established to prevent the spread of the insect by transportation of infested trees and branches. Early detection and rapid treatment are crucial to successful eradication of the beetle. Eradication efforts continue in the Chicago area and in New York and New Jersey. The results of eradication efforts in Chicago have been very promising and quarantines were removed in the communities of Summit and Addison in 2004.

iii. Emerald Ash-Borer

The emerald ash-borer (*Agrilus planipennis*) is an exotic Asian beetle discovered in July 2002 feeding on ash trees in southeastern Michigan. Larvae feed in the cambium between the bark and wood, producing galleries that eventually girdle and kill branches and entire trees. As of 2004, more than 3,000 square miles in southeast Michigan were infested and more than six million ash trees were dead or dying from this pest. In 2003, newly established populations were detected in other areas of southern Michigan and several locations in Ohio.

iv. Banded Elm-Bark Beetle

The banded elm-bark beetle (*Scolytus schevyrewi*) was detected in Colorado and Utah in May 2003. It is native to China, Russia, Mongolia and Korea. Hosts in its native range include elms, willows, Russian olive and *Prunus* species; but currently it has been found only in elms in the United States. More recent detections have been made in Kansas, New Mexico, Nebraska and Nevada. It is uncertain what, if any, effect this insect may have on forests of North America; but it is yet another example of the potential danger posed by exotic pests.

v. Sudden Oak Death

Sudden oak death is caused by a fungus-like organism, *Phytophthora ramorum*, the origin of which is unknown. In North America, it has been found along the central California coast up into southwest Oregon. The pathogen causes cankers that kill canyon live oak and California black oak. In Europe and in controlled tests, the pathogen has been shown to infect pin and northern red oak. Presumably all members of the red-oak group are susceptible. In addition, it infects the foliage of dozens of other trees and herbaceous plants.

In nurseries, the pathogen has been found on rhododendrons, viburnums and other common landscape plants. In the spring of 2004, infected nursery plants were shipped to every state in the country. Spores have been found in nursery and forest soils and can be transmitted in potting material and on hikers' boots. Surveys conducted subsequently around nursery perimeters and in forests throughout the east have been negative for the pathogen to date. Many of the infected plants could not be tracked and their ultimate fate remains uncertain.

It is unknown what the potential is for *P. ramorum* to become established and cause damage in the east; but, judging from the widespread mortality in California, it is ominous. Once established, eradication of any organism is virtually impossible. Containing infection and slowing spread are the best options and this demands aggressive intervention. Attempts to eradicate isolated infections in southwest Oregon include clearcutting infection centers and buffers around each center, broadcast-burning of debris and applying herbicide to stump-sprouts. Continued vigilance through monitoring will be required to prevent its establishment on the Forest.

4. NON-NATIVE INVASIVE SPECIES

Non-native invasive species are of concern not only on the Forest but also nationwide because they compete with native or more desirable species. Mortensen (2003) and Miller (2003) present some of the more prominent non-native invasive plant species that could affect the Forest along with suggested control methods. Huebner *et al.* (2004) present an ecological perspective of plant invaders of forests and woodlands, as well as a useful list of references for fifteen potential invasive herbs, vines, shrubs and trees in the Eastern Region of the National Forest System.

Some of the most common and problematic non-native invasive plant species in the Hoosier-Shawnee assessment area include: garlic mustard, purple loosestrife, crownvetch, cinnamon vine, Japanese honeysuckle, sweet clover, Nepalese browntop, Reed canarygrass, tree of heaven, autumn olive, tall fescue, ground ivy, lespedezas, creeping jenny, Fuller's teasel, common periwinkle, multiflora rose, Japanese hop, Johnsongrass, nodding musk thistle, phragmites and kudzu (Olson *et al.*, 2004). The IDNR and the Forest have identified additional invasive plants in southern Illinois as part of a cooperative weed management program. These include amur honeysuckle, Chinese yam, curly leaf pondweed, Eurasian water-milfoil, Japanese knotweed, Japanese stiltgrass, oriental bittersweet, princess tree and sawtooth oak.

Non-native invasive plants can have a serious adverse effect on biological, economic, social and aesthetic values. For example, kudzu totally replaces native vegetation, including climbing over and killing trees and other vegetation. Autumn olive is an aggressive invader that quickly occupies oldfields. Garlic mustard is appearing in greater numbers along heavily traveled trails. These are just a few examples of the damage that can be done by non-native invasive species that replace native species and biological diversity.

Non-native invasive species can be introduced into native ecosystems by transport of seed on vehicles or equipment, soles of shoes, manure from domestic or wild animals, or dissemination by wind and water. The effects of non-native invasive species can be minimized by prevention and treatment. Examples of preventive measures include the use of wash stations to clean equipment and the use of clean seed. All timber harvest contracts include a requirement to clean equipment prior to logging operations to minimize the possibility of accidental introduction or spread of non-native invasives. Monitoring of forest management activities and areas of use is necessary to prevent the establishment of non-native invasive species and to control them.

Methods of control include manual and/or mechanical control, such as cutting or pulling plants, the application of fire through spot-burning or prescribed fire, biological control such as releasing insects that damage the target organism and chemical control involving pesticides to manage invasive species. The identification of successful control methods requires site-specific environmental analyses and decisions under NEPA.

Most of the problems with non-native invasive species that have an effect on forest health involve invasive plants. However, some animal species, such as feral hogs that root on the forest floor, could possibly have impacts on forest health if populations increase.

5. TIMBER HARVEST AND REGENERATION

Of the 284,600 acres of the Forest, 117,400 acres in the Even-Aged Hardwood management area are tentatively suitable for timber production. Appendix C of the Forest Plan includes a detailed description of the silvicultural management practices envisioned for use under the Forest Plan.

Since the late 1960's, the primary silvicultural system used on the Forest for both hardwood and pine-stands has been even-aged management. Clearcutting has been the dominant method used to harvest hardwood stands and improvement-cutting by thinning has been used almost exclusively in pine stands. An average of 900 acres of hardwood was clearcut and regenerated each year until the mid-1980’s. A yearly average of 1,785 acres of pine was commercially thinned prior to 1987.

The 1986 Forest Plan prescribed even-aged management as the probable silvicultural system, but provided for the use of uneven-aged management to meet certain objectives. Uneven-aged management (group selection) has been applied on a limited number of hardwood areas starting in 1989 and was the probable silvicultural system prescribed in the 1992 amended Forest Plan.

Since the mid-1980’s, timber-sale activity was drastically reduced and eventually stopped by litigation often dealing with effects on threatened and endangered species and management indicator species. The acreage of group-selection cutting was limited to 195 acres in 1993, 38 acres in 1995 and 31 acres in 1996. No other hardwood-timber sales have been cut since 1992. Pine shelterwood-cuts averaged 213 acres from 1992 through 1995 and a few acres were also cut in 1997 and 1998.

Restricted cutting has resulted in a shift in timber-size classes on the Forest. When comparing acres by size-class from the 1985 forest inventory (Hahn, 1987) with the 1998 inventory (Bretthauer and Edgington, 2002), sawtimber stands increased from 60.7 percent to 71.4 percent. In the same period, poles decreased slightly from 26.6 to 25.6 percent. Seedling-sapling area changed from 12.7 percent of the forested area in 1985 to three percent in 1998.

Tree-planting for the period 1992 through 2002 ranged from no program in 1993 to 1,525 acres in 2000, averaging 464 acres annually. Recent planting has been on newly acquired open bottomlands in the Mississippi River floodplain. Timber-stand improvement averaged 164 acres annually from 1992 to 1998. No timber-stand improvement has been done on the Forest since that time.

The limited ability of oaks to regenerate under the shade of a maturing forest is a special concern. A comparison of the 1985 and 1998 forest inventory data shows that the total number of small-diameter oaks has generally decreased while the shade-tolerant hard maples have increased. White oaks in the 1-2.9- and 3-4.9-inch DBH-classes decreased from 5.2 million to 3.7 million. Although the number of red oaks in the 1-2.9-inch class increased by about 6 percent (from 3.1 million to 3.3 million), red oaks in the 3-4.9-inch class decreased by over 60 percent (from 1.4 to 0.5 million) between 1985 and 1998. During that same period, the shade-tolerant hard maples increased by 19 percent in the 1-2.9-inch class and 79 percent in the 3-4.9-inch class (Haugen, 2002).

Most of the present-day forests in the region dominated by oak-hickory species are a result of centuries of widespread human disturbance (Barrett, 1995; Parker and Ruffner, 2004; Abrams, 1992; Lorimer, 1993, as cited in Parker and Ruffner, 2004). The prehistoric and historic influence of human disturbance on the forests of southern Illinois is discussed by Parker and Ruffner (2004). Without disturbance, oak-hickory forests will succeed to a mixture of more shade-tolerant species (Abrams, 1992, as cited in Barrett, 1995). The fire-control policies initiated in the early 1900’s have resulted in the expansion of the mixed mesophytic species in the region (Fralish *et al.*, 1991).

The change in species by size-class and the fact that oak requires disturbance in order to be regenerated, indicate that many of the Forest’s oak-hickory stands are regenerating to the more shade-tolerant maple species. As these stands continue to age without disturbance, vigor will decrease and stress from insects, pathogens and other factors will continue to increase. A number of interacting factors contribute to oak decline including stand, site, abiotic and biotic factors (Starkey *et al.*, 2004), including physiological age, density, competition, drought and boring and defoliating insects. The Mark Twain National Forest in neighboring Missouri recently has experienced oak decline on hundreds of thousands of acres (Law *et al.*, 2004).

DIRECT AND INIRECT EFFECTS ON FOREST ECOSYSTEM HEALTH AND SUSTAINABILITY

1. Restrictive Management

Under any alternative, timber harvest would not be scheduled in restrictively managed areas, but could be used to achieve resource-management objectives. Because harvest would be limited, less timber-volume would be available under each of the alternatives. In addition, the reduced disturbance in these areas due to the removal of fewer trees would contribute to the conversion of forest-types from oak-hickory to more-mesic species, especially maple and beech, an indirect, adverse effect—albeit limited in scope. With regard to the timber resource, there is no substantial difference among Alternatives 1, 2 and 4, since the acreage of restrictively managed areas under each is similar. Since no cutting of trees is allowed under Alternative 3, the entire Forest would be under restrictive management.

All of the restrictive-management prescriptions allow for fire use in a manner supportive of the specific emphasis for each area. Under any alternative the effects of fire use in the restrictively managed areas would be indirect and beneficial through the influence of fire on vegetation and, additionally, through the reduction of fuel-loading. If fire use should not be implemented in these areas, or wildland fires suppressed, the potential for larger wildland fires could be greater—an adverse, indirect effect.

2. Roads and Trails Management

Under any alternative, roads and trails management is an important component of maintaining forest health and sustainability since these travelways provide access for Forest-management activities. The presence of roads and trails may require special visual corridors that could limit timber-harvest activities in areas directly adjacent to the travelway. Roads and trails also provide access for wildland fire-suppression and fire-use applications and serve as potential fire control-lines as well, all beneficial direct and indirect effects. Under any alternative over 3,700 miles of state and county roads also provide access to the Forest for fire-suppression and use.

Under any alternative, the management of roads and trails generally would have no direct effects on forest health or the timber resource. However, if roads and/or trails should be improperly located, or erosion-control measures not implemented, soil erosion could occur, potentially leading indirectly to the adverse effect of reduced timber production and reduced forest health. Therefore, mitigation measures implementing best-management practices—such as the proper location of skid-trails and temporary roads, the seeding and mulching of exposed soil, installation of water-bars and adequate maintenance—would be required.

Under any alternative, existing roads could provide opportunities for the dissemination of non-native invasive species and the displacement of native species. This adverse, indirect effect can be mitigated as described above in the discussion on non-native invasive species. Under Alternatives 1, 2 and 4, land occupied by roads or trails would be removed from timber production—an indirect, adverse effect.

a. Alternative 1

The uneven-aged timber management under Alternative 1 would require roads to be constructed or reconstructed more frequently than under other methods. This system does not necessarily require more miles of road; but, since harvest is more frequent on any given tract of land, the roads needed must be constructed sooner and maintained for a longer period. This alternative would provide about 590 miles of Forest Service system roads and envisions up to 286 miles of ATV/OHM travelways and up to 338 miles of equestrian-hiker trails that could provide Forest-access and control lines for wildland fire suppression and fire use.

Implementation of Alternative 1 would result in the greatest, adverse indirect road-effects of all the alternatives because of the more frequent entry schedule and the requirement for special mitigation measures along roads and trails for visual quality management. Implementation of this alternative could also result in the greatest beneficial, direct and indirect effects of all the alternatives because it would provide slightly better access for forest management and fire-suppression activities than Alternatives 2 and 3 through the more-frequent reconstruction of roads required under uneven-aged management and because access for a greater number of wildlife openings would be maintained under this alternative.

b. Alternative 2

The even-aged management with shelterwood-harvest under Alternative 2 would require fewer entries for cutting than under the uneven-aged system and any required new roads could be constructed and/or reconstructed over a longer period of time than under Alternative 1. Implementation of Alternative 2 would, therefore, result in relatively less adverse, indirect effects than Alternative 1, about the same as Alternative 4, but more than Alternative 3, except in terms of fire use and fire-suppression and access to wildlife openings.

This alternative would provide about 590 miles of Forest Service system roads and envisions up to 700 miles of equestrian-hiker trails that could provide Forest-access and control-lines for wildland-fire suppression and fire use. It would not include the 286-mile ATV/OHM travelway corridor found under Alternatives 1 and 4 and, therefore, would not offer as much opportunity for the dissemination of non-native invasive species as Alternatives 1 and 4. In terms of fire use and fire suppression and access to wildlife openings, implementation of Alternative 2 would have beneficial, direct and indirect effects, slightly less than Alternative 1, but more than Alternatives 3 and 4.

c. Alternative 3

Because there is no scheduled timber harvest under this alternative, there would be no road construction and/or reconstruction for timber-harvest purposes. With decreased road construction, the direct effects of roads and trails on forest health and sustainability would be the least of the alternatives. This alternative does not include the 286-mile ATV/OHM travelway corridor found under Alternatives 1 and 4 and, therefore, would not offer as much opportunity for the dissemination of non-native invasive species as Alternatives 1 and 4.

This alternative would provide about 590 miles of Forest Service system roads and envisions up to 400 miles of equestrian-hiker trails that could provide Forest-access and control lines for wildland fire suppression and fire use. Therefore, implementation of Alternative 3 would result in slightly less beneficial, indirect effects than the other alternatives.

d. Alternative 4

The even-aged management system under this alternative proposes shelterwood-harvest with reserves, requiring fewer entries for cutting than under uneven-aged management. Any required roads could be constructed and/or reconstructed over a longer period of time than under Alternative 1. Implementation of Alternative 4 would, therefore, result in relatively less adverse, indirect effects than Alternative 1, about the same as Alternative 2, but more than Alternative 3, except in terms of fire use and fire suppression and access to wildlife openings.

This alternative would provide 590 miles of Forest Service system roads and envisions up to 286 miles of ATV/OHM travelways and up to 700 miles of equestrian-hiker trails that could provide Forest-access and control lines for wildland fire suppression and fire use. In terms of fire use and fire-suppression and access to wildlife openings, implementation of Alternative 4 would result in the greatest beneficial, direct and indirect effects of all the alternatives.

3. Recreational Use of Roads and Trails

The direct and indirect effects of the recreational uses of roads and trails are anticipated to be minimal under any alternative, assuming adequate road and trail maintenance and appropriate mitigation. Use by motorized vehicles and equestrians without adequate maintenance and mitigation could lead to soil erosion and compaction, indirectly and adversely affecting the health and sustainability of the Forest and the introduction of non-native invasive species, with direct and indirect, adverse effects. A localized, direct and adverse effect could also result immediately adjacent to a trail or road, where roots may be damaged.

4. Dispersed Recreational Use

The direct and indirect effects of all recreational uses are anticipated to be minimally adverse under any alternative. Under Alternative 1, the effects of equestrian cross-country use and use of user-developed trails would be similar to those described for recreational use of roads and trails described above.

5. Developed Recreational Site Use

The direct and indirect effects of all developed recreational site uses are anticipated to be minimal under any alternative.

6. Timber Harvest

Various timber harvest methods are available under Alternatives 1, 2 and 4. Group-selection is the probable method of harvest for hardwoods under Alternative 1; shelterwood is the probable method for hardwoods under Alternative 2, with shelterwood-with-reserves proposed in forest-interior blocks; and shelterwood-with-reserves is the probable method under Alternative 4. The shelterwood-with-reserves harvest method is applied to all pine harvests under Alternatives 1, 2 and 4. No timber harvesting is allowed under Alternative 3.

Table 3-10 presents the acreage of timber harvest by method for hardwoods and pine by alternative in the first decade for land considered suited and unsuited for timber production. The acreages of shelterwood and shelterwood-with-reserves will about double in the second decade when the second shelterwood entry is made. Thinning of hardwood bottoms may be implemented in the forest-interior blocks to help maintain desired habitat for interior species under Alternatives 2 and 4.

Table 3-10. Timber-harvest acreage by method, alternative and forest-type during the first decade on suited and unsuited lands.

Alternative Forest-Type	Group Selection		Shelterwood		Shelterwood with Reserves		Thinning	
	Suited	Unsuited	Suited	Unsuited	Suited	Unsuited	Suited	Unsuited
Alternative 1								
Hardwood	2,770	0	0	0	0	0	0	0
Pine	0	0	0	0	0	4,380	0	0
Alternative 2								
Hardwood	0	0	3,197	659	1,500	400	263	95
Pine	0	0	0	0	3,814	586	0	0
Alternative 3								
Hardwood	0	0	0	0	0	0	0	0
Pine	0	0	0	0	0	0	0	0
Alternative 4								
Hardwood	0	0	0	0	3,393	1,642	512	630
Pine	0	0	0	0	3,838	562	0	0

The timber-harvest volumes possible from suited and unsuited lands in the first ten years of revised-Plan implementation are presented in Table 3-11. Timber volumes from lands considered suited for timber production are included in the allowable sale quantities as part of a timber management program. Trees harvested from lands considered unsuited for timber management are removed for reasons other than timber production, usually for the maintenance or improvement of wildlife habitat.

Table 3-11. Timber-harvest volumes by alternative and forest-type during the first decade on suited and unsuited lands (in thousands of cubic feet).

Alternative Forest-Type	Suited	Unsuited
Alternative 1		
Hardwood	1,665	0
Pine	0	6,834
Alternative 2		
Hardwood	1,814	459
Pine	5,937	896
Alternative 3		
Hardwood	0	0
Pine	0	0
Alternative 4		
Hardwood	1,834	940
Pine	5,973	860

The alternatives directly affect the age- and size-classes of the trees that populate an area of ground that has been harvested and indirectly affect the long-term sustainability of the oak-hickory forest-type. Utilizing the Forest Vegetation Simulator growth projections and the Spectrum harvest-scheduling model, Table 3-12 displays the acreage of oak-hickory and maple-beech forest-types and -sizes by alternative at 150 years in the future.

This projection is a conservative estimate of the change from oak-hickory to the maple-beech forest-type when compared to projections by Fralish *et al.* (2002) and others. Regarding a white oak-yellow poplar community on the Kaskaskia Experimental Forest in the Shawnee Hills, Schlesinger (1989) predicts that, if the observed rate of maple-increase continues, sugar maple will exclude all other species within 50 to 60 years. In the Illinois Ozarks, few stands will be dominated by oak-hickory species in 75 to 100 years and, in the Greater and Lesser Shawnee Hills subsections, about two-thirds of the forest will convert to sugar maple and mesophytic species (Fralish *et al.*, 2002). Based on data from Helmig (1997) for the Illinois Ozark Hills, the conversion-threshold from an oak-hickory–dominated forest to a mesophytic forest is projected to occur between 2045 and 2050 (Fralish *et al.*, 2002).

Table 3-12. Projected long-term (150 year) age-/size-class distribution for the oak-hickory and maple-beech forest-types on the SNF (in acres).

Forest-Type Age/size-class*	Alternative 1	Alternative 2	Alternative 3	Alternative 4
Oak-Hickory	Acres			
Seedlings/Saplings	4,284	13,848	1,431	13,294
Posts/Poles	14,537	54,957	4,067	54,901
Sawtimber	25,048	59,136	4,022	62,185
Old Growth	122,902	64,835	106,288	64,664
Total	166,772	192,776	115,808	195,045
Maple-Beech	Acres			
Seedlings/Saplings	2,850	2,852	2,850	2,848
Posts/Poles	5,699	5,704	5,699	5,697
Sawtimber	8,999	8,701	8,723	8,675
Old Growth	57,832	42,858	109,371	41,676
Total	75,380	60,115	126,643	58,897

*Size-classes based on ages: seedling/saplings = 0-20 years, post/poles = 20-70 years, sawtimber =70-120 years and old growth = 120+ years.

a. Alternative 1

i. Uneven-Aged Management – Group-Selection

Uneven-aged management using group-selection would be the probable method of timber harvest under Alternative 1. Although group selection has been proposed as a silvicultural option in upland hardwoods (Minckler 1987 and Fischer 1979), others disparage its use (Roach, 1974). Sugar maple, red maple, American beech and other shade-tolerant species tend to replace less shade-tolerant species in some parts of the central hardwood region, and the process occurs most rapidly on good sites (Johnson 1989). The use of group-selection would hasten the transition of oak-hickory to later successional species, as has been documented since the mid-1980's by Parker and Ruffner (2004). Implementation of group-selection in the absence of advanced oak-hickory regeneration would result in the adverse, indirect effect of accelerating the conversion of cut groups from oak-hickory to more-mesic beech-maple.

ii. Uneven-Aged Management – Single-Tree Selection

Although allowed under this alternative, it is unlikely that this harvest method would be used in hardwood stands and it would not be used in pine. Single-tree selection would remove selected sawtimber-sized trees and pole- and sapling-sized trees. Harvesting sawtimber-size trees would reduce the overstory canopy and so increase the sunlight reaching the forest floor. Harvest would occur about every 20 to 30 years. Damage to residual vegetation from skidding is expected to be the highest per unit-area entered of all harvest methods.

Although single-tree selection has been used successfully to maintain oak-hickory on xeric, oak-dominated sites in the Missouri Ozarks, where oak regeneration tends to accumulate (Iffrig *et al*., 2004), it is not likely to be successful on sites where oak regeneration does not accumulate (Johnson *et al*., 2002). The ecological conditions created by single-tree selection would result in the regeneration of the more shade-tolerant species present in the stand (Heiligmann *et al*., 1985; Trimble, 1970; Johnson, 1989) and so is appropriate only for stands in which the desired species-composition is shade-tolerant (Leak and Gottsacker, 1985). High light-levels are necessary for the survival and growth of advanced oak regeneration. These light conditions cannot be achieved by the single-tree selection method (Fisher, 1987).

As the predominant oak-hickory forest gradually converts to a moderately shade-tolerant species-mix, the tolerant trees' growth and vigor would generally decrease. This results because the tolerant species, primarily beech and maple, generally exhibit a greater susceptibility to decay and are naturally slower-growing compared to intolerant and moderately tolerant species. Over the long term, this species-type change would result in the development of a higher proportion of lower-quality, slower-growing trees throughout the Forest. This mature, old-growth forest would not maintain the vigorous forest growth necessary to reduce insect and pathogenic problems; but, rather, would create the conditions that predispose the forest to destructive outbreaks of these problems.

iii. Even-Aged Management – Shelterwood with Reserves

Shelterwood-with-reserves would be used primarily in pine-stands. The increase in sunlight following the harvest would trigger an immediate growth-response from the understory, primarily hardwood, seedlings. In some cases, oak-hickory advanced-regeneration would be present and, in others, light-seeded species such as elm, ash, maple and yellow poplar would dominate. The species composition would depend upon what is present before the cut is made and seed that is available for germination following the harvest operations. Stocking surveys following past shelterwood harvests have shown well-stocked, native-hardwood regeneration and good percentages of oak-hickory regeneration.

Although a study by Arnold (1967) showed that a reduction of overstory-pine density reduced the total amount of hardwood reproduction by 13 to 22 percent from the 5,500 seedlings per acre on the control plots, this still left a well-stocked hardwood understory, and thinning had a favorable effect on the growth of the hardwood seedlings. The understory would be dominated by a thick, native hardwood stand. In some cases, pine seedlings would be a part of the new stand. Except in stands of native shortleaf pine, however, pine is not expected to dominate the reproduction. Prescribed fire and timber-stand improvement activities would be needed to favor the oaks and hickories over competing light-seeded species.

The residual overstory of 20 to 40 square feet of basal area in the shelterwood-with-reserves harvest—which would be left for an indefinite period of time—would cause a minor reduction in the growth of the new stand through the sapling and pole-sized classes. Any overstory mortality caused by age, insects, pathogens, or storm damage would increase sunlight to the new stand. The removal of the residual overstory at some point in the future may be necessary in some situations to promote the health and growth of the hardwoods.

Implementation of Alternative 1 would result in the indirect, adverse effects related to the advancement of beech-maple dominance and the resultant loss of forest vigor and health.

b. Alternative 2

i. Even-Aged Management – Shelterwood

Even-aged management using shelterwood harvest would be the probable method of timber harvest under Alternative 2. It is an appropriate regeneration method where essential advance reproduction is lacking (Johnson, 1989), and site preparation is sometimes necessary to assure regeneration success. The objective of the shelterwood method is to create conditions favorable for the establishment and development of tree reproduction of the desired species beneath the parent stand (Johnson *et al*., 2002). Most oaks favor partial shade for establishment. The advantage of the shelterwood harvest is that the overstory oak-hickory seed-source can be retained until adequate advance regeneration is established.

An effective shelterwood system must not only reduce overstory density, but also control the understory to achieve adequate light at ground level (Sander, 1979). Because all tree seedlings—not just oaks—are released with a reduction in overstory, some method of understory treatment is necessary to favor oak-hickory over the more shade-tolerant beech-maple. These methods could include repeated prescribed fire, chemical and/or mechanical release. Success of oak-hickory regeneration increases with the use of scarification and the repeated use of prescribed fire. Additionally, the underplanting of oaks may be necessary on highly productive sites where advanced oak-hickory reproduction is difficult to establish.

Several studies have shown success in regenerating oaks using the shelterwood harvest method in conjunction with the control of understory competition (Johnson *et al*., 1989; Schmeckpepper *et al*., 1988; Lorimer, 1989). Implementation of Alternative 2 would result in the beneficial, direct and indirect effects related to reduction of the overstory canopy, the resulting increase in the amount of sunlight reaching the forest floor and the improvement of the chances for moderately shade-tolerant or shade-intolerant species to germinate and improve growth on existing advanced reproduction. Implementation would also result in the beneficial, indirect effect of maintaining more of the oak-hickory forest-type over the long term—more than under Alternatives 1 and 3 and a similar amount to Alternative 4.

ii. Even-Aged Management – Shelterwood with Reserves

In the shelterwood-with-reserves harvest method, trees are retained after reproduction is established to obtain goals other than regeneration (Johnson *et al*., 2002). Under Alternative 2, shelterwood-with-reserves would be used primarily in pine-stands for visual-resource management and on ridges and upper slopes in forest-interior blocks for forest-interior habitat management. The increase in sunlight following the one-to-three required cuts would trigger an immediate growth-response for understory, primarily hardwood, seedlings. In some cases, oak-hickory advanced-regeneration would be present and, in others, light-seeded species such as elm, ash, maple and yellow poplar would dominate. The species composition of the new stand would depend upon what is present before the final entry is made.

The understory would be dominated by a thick, native hardwood stand. In pine stands, pine seedlings would be a part of the new stand. Except in stands of native shortleaf pine, however, pine is not expected to dominate the reproduction. Prescribed fire and timber-stand improvement activities would be needed to favor the oaks and hickories over competing light-seeded species (Sander, 1979; Lorimer, 1989; Weigel, 1999; Wright *et al*., 1985; Jokela and Sawtelle, 1985).

The residual overstory of 20 to 40 square feet of basal area in the shelterwood-with-reserves harvest—which would be left for an indefinite period of time—would cause a minor reduction in the growth of the new stand through the sapling and pole-sized classes. Any overstory mortality caused by age, insects, pathogens, or storm damage would increase sunlight to the new stand. Miller *et al*. (2004) studied the composition and development of reproduction in two-aged hardwood stands, 20 years after a shelterwood-with-reserves harvest. They found that the crowns of the residual, overstory trees had expanded by nearly 80 percent and collectively covered almost half of the stand area. Desirable shade-intolerant species had remained competitive only in areas located between the crowns of the residual overstory trees. The areas located beneath the residual, overstory trees were occupied by shade-tolerant species such as sugar maple, red maple and American beech. The removal of the residual overstory at some point in the future could be necessary in some situations to promote the health and growth of the hardwoods.

Implementation of a shelterwood-with-reserves harvest would have the beneficial and direct effect on timber resources of reducing the overstory canopy, increasing the amount of sunlight reaching the forest floor. This would improve the chances that species considered moderately shade-tolerant or shade-intolerant, to germinate and improve growth on existing advanced reproduction. Most oaks favor partial shade for establishment. The advantage of the shelterwood-with-reserves harvest method is that the overstory oak-hickory seed-source is retained to ensure that adequate advance regeneration is established. The beneficial and indirect effect of this method would be the maintenance of more of the oak-hickory forest-type over the long term than would occur under Alternatives 1 and 3 and a similar amount to Alternative 4.

iii. Even-Aged Management – Clearcutting

Clearcutting would be done very rarely, if ever. It may be employed to favor a threatened, endangered or sensitive species, or in the event storm damage could result in an insect or disease outbreak without its use. Clearcutting can favor the establishment and development of shade-intolerant species and provide optimum light conditions for the rapid growth of relatively intolerant oaks and other intolerant species.

The effects of clearcutting on oak-hickory regeneration depend on the site and the presence of advanced oak-hickory regeneration. In general, advanced reproduction of oak is more abundant on sites with average to poor site indices than on good sites. The accumulation of oak seedlings increases with a decreasing overstory-density. Clearcutting can facilitate good oak-regeneration when the advanced regeneration is present before the cut. Because of the difficulty of obtaining and accumulating oak-regeneration on good sites, clearcutting generally does not result in a large percentage of oak in those areas.

In oak-hickory forests where oak regeneration is lacking and maple has become established in the understories, timber harvest can accelerate the dominance of maple in the canopy (Abrams and Nowacki, 1992). Fischer (1987) found that clearcutting on the Hoosier National Forest resulted in less oak than was present in the harvested overstory. Similar results are expected from clearcutting on the SNF. Because all trees are cut at one time, damage to the residual stand is not the concern that it is with other harvest methods. Trees on the borders of clearcuts could be subject to damage when located near a skid trail.

iv. Thinning

Thinning of hardwood bottoms could be implemented in the forest-interior blocks to help maintain desired habitat for interior species. This would be a light thinning in an effort to maintain some of the white oak in the bottoms within the forest-interior blocks. The direct effects would be a moderate increase in sunlight for the release of younger oaks without increasing competition in the understory from more-mesophytic species. This would only be approached on a very limited basis, and would require close monitoring to ensure that objectives are being met.

c. Alternative 3

Alternative 3 allows no timber harvest and permits natural pine mortality, with no timber harvest except in special cases, such as for the protection of human health or administrative needs. Generally, the pine overstory would likely persist for several more decades. In some cases, there could be pine damage due to insects, pathogens or wind. Due to their crowded condition, the pine crowns would continue to decline, in many cases appearing thin and spindly. Lack of sunlight to the forest floor would hinder native hardwood development in the understory.

Due to the lack of disturbance, this alternative would, in the long term, result in the succession of much of the oak-hickory–dominated plant communities to mixed-mesophytic plant communities dominated by maple-beech. It would not maintain the vigorous forest growth necessary to prevent insect and pathogen problems; but, rather, would create the conditions that predispose the forest to destructive outbreaks of these problems. Thus, implementation of Alternative 3 would result in the greatest adverse indirect effects of the alternatives and advance the dominance of the maple-beech forest-type and the subsequent loss of forest diversity, vigor and health.

d. Alternative 4

Under this alternative, shelterwood-with-reserves would be the probable method of timber harvest in order to avoid the visual effects of the final overstory removal. The end-result of not removing the overstory is a reduction in the volume of timber utilized from that stand. Thinning would also be allowed in the hardwood bottoms of forest-interior blocks to help maintain some of the white oak. For a discussion of direct and indirect effects, see Alternative 2 at section 6b, above.

7. Vegetation Treatments

a. Alternatives 1, 2 and 4

Because all tree seedlings—not oaks only—are released with a reduction in overstory density, some method of understory treatment is necessary to favor oak-hickory over the more shade-tolerant beech-maple and other light-seeded competition. These methods could include repeated prescribed fire and chemical and/or mechanical release. Control of understory competition may also be necessary for the maintenance of planted oaks, especially on more productive sites (Weigel, 1999).

Alternatives 1, 2 and 4 allow timber-stand improvement for the management of species-composition. Generally, this would involve cutting or killing trees to favor oak-hickory, although prescribed fire also could be used for fuels-reduction, timber-stand improvement and/or site-preparation. This treatment usually takes place in young stands ranging in age from 10 to 40 years. The growth within these stands is concentrated on fewer more desirable trees from a species and tree-form standpoint. This, in turn, would result in stands that are higher in wildlife and timber value.

The use of herbicides in timber-stand improvement would increase the ability to favor oak-hickory over maples and other species (Loftis, 1988). When only cutting is used, maple stumps do not die, but continue to sprout. The selective use of herbicides would eliminate the maple-sprouting and allow the effective and efficient selection of desirable species.

The programmatic effects of herbicide applications have been documented by the Southern Region of the Forest Service in EISs for vegetation management in the Appalachian Mountains, the Coastal Plain-Piedmont Region and the Ozark-Ouachita Mountains. Since these EISs address ecological regions on or similar to the Forest and since the documented effects would be similar to effects on the Forest, these documents and their amendments are incorporated here by reference. A number of specific mitigation measures for herbicide applications are listed in the records of decision to minimize adverse effects on the environment by protecting human health and safety; non-target vegetation; wildlife; threatened, endangered and sensitive species; soil, water and aquatic life; air quality; visual quality and cultural resources. These documents and mitigation measures will be utilized in the implementation of the Forest Plan to support site-specific analyses and minimize the effects of implementing specific vegetation-management treatments.

Tree-planting would also be done to help ensure oak-hickory regeneration in existing oak-hickory stands, both in upland forests and at Oakwood Bottoms Greentree Reservoir. Planting will also be utilized to establish bottomland hardwoods on acquired lands in the Mississippi and Ohio Rivers Floodplains management area.

Implementation of these alternatives would result in the beneficial, indirect effect of maintaining the oak-hickory forest-type and the beneficial, direct effect of protecting the Forest from wildfires. Any adverse effects of these treatments are anticipated to be minimal.

b. Alternative 3

Under Alternative 3, no vegetation treatments would be allowed other than limited prescribed fire and tree and shrub removal in natural areas for the maintenance of barrens communities and threatened, endangered and sensitive species. Natural selection and mortality would determine the value, form and species that would survive in most forest stands. This would result in less oak-hickory forest-type and more conversion to beech-maple over much of the Forest. This conversion would result over time in a mature, old-growth forest across the landscape. It would not maintain the vigorous forest growth necessary to prevent insect and pathogen problems; but, rather, would create the conditions that predispose the forest to destructive outbreaks of these problems.

Tree-planting could be utilized for the reforestation of wildlife openings and openland tracts, and to establish bottomland hardwoods on acquired lands in the Mississippi and Ohio Rivers Floodplains management area.

Implementation of this alternative would result in the adverse, indirect effects of advancement of the maple-beech forest-type and the subsequent loss of forest diversity, vigor and health.

8. Fire Management

Prescribed fire can harm or benefit vegetation, depending on plant characteristics, fire-type and behavior, topography, wind speed, temperature, length of exposure and season. Fire can damage plant leaves, buds, stems, bark, branches and roots. The extent of the injury would depend upon species, age, diameter, height and protective adaptations. Young, succulent and actively growing vegetation is especially vulnerable (Loomis, 1973). Protective adaptations, such as buried meristems, thick bark, protected buds, ability to re-sprout and natural pruning of lower branches decrease the risk of plant injury or death (Gill, 1981; Van Lear, 1985).

Prescribed fires can change the environment in which plants grow. They remove the litter from the ground-surface and temporarily reduce other woody or herbaceous species that compete for the same growing-space, moisture, nutrients and light required for optimal success in germination and establishment. Komarek (1974) reported that some species of orchids are adapted to frequent fires and are unable to compete in litter accumulations or with woody species for light and nutrients.

Species-composition changes occur with increased fire intensity and frequency. Season of burn is also an important variable. More-intense fire causes greater shifts in species-composition by reducing small, woody species (less than three inches in diameter at chest height), by increasing the abundance and diversity of herbaceous species through the preparation of more favorable seedbeds (Van Lear and Johnson, 1983) and by decreasing canopy-closure of the woody overstory. Sanders (1985) found that herbaceous species increased after one low-intensity burn, but that the increase was not significant. As fire-intensity increases, legumes and other forbs and grasses are especially favored (Cushwa *et al.*, 1966; Czuhai and Cushwa, 1968).

The application of prescribed fire increases herbaceous-species diversity and is a necessary disturbance for the success of annual plants. Fire exposes patches of bare soil and stimulates the germination of annuals, such as *Cassia fasiculata* and *Crotolaria sagittalis*. The removal of the duff-layer by fire also increases soil temperature and the amount of available light. A drier soil-moisture regime, in combination with an increase in available solar radiation, results in barrens and dry-forest species and enables them to out-compete the shade-tolerant, mesic-adapted species currently occupying the sites (Spurr and Barnes, 1980).

Temperature, length of exposure and season significantly affect plant survival. Dormant-season fires top-kill woody species, but do not significantly affect rootstocks of hardwoods; growing-season fires not only top-kill stems, but also kill the roots of many hardwoods (Lotti *et al*., 1960). Burns conducted during the latter part of the growing season are less effective due to difficulties with higher levels of humidity and fuel-moisture-levels.

Short-interval (every one to three years) dormant-season burns are necessary to restore barrens and open-woodlands. When low-intensity, dormant-season fires are used; most woody species are only top-killed and re-sprout vigorously the following spring. Short-interval prescribed fire would deplete root-reserves and cause individual plants to be more susceptible to damage from insects and disease. Fennell and Hutnik (1970) reported that hardwood species most severely damaged by fire, through decay losses, were dogwoods, maple and beech, followed by hickories, black gum, elm and ash. Least damaged were oaks, yellow poplar and black walnut. Short-interval, dormant-season prescribed burns have resulted in decreased canopy-closure and a decrease in the number of stems per acre on barrens restored on the Forest. Once the prescribed level of canopy-closure is met, a long-interval (five to ten years) prescription can be implemented.

Xeric and dry-upland forests, barrens and open-woodlands are native plant communities that evolved with fire (Curtis, 1959; Engelmann, 1863; Bacone and Post, 1986). Their associated native-plant species have evolved to adapt themselves to periodic fires. These fire-dependent communities have succeeded towards dry-mesic, forested conditions due to the exclusion of fire (Bourne, 1819; Anderson and Schwegman, 1971; McInteer, 1944; Johnson, 1986; Frost *et al.*, 1986; Smeins and Diamond, 1986). Prescribed fire has been demonstrated to be effective in restoring and maintaining these unique communities.

Studies have shown the beneficial effects of fire and prescribed fire in relation to oak regeneration. Keyser, *et al.* (1996) showed that the competitive position of upland oaks in the advance regeneration pool can be enhanced by prescribed fire in shelterwood stands, and that the density and height of oak advance regeneration are not adversely affected by fire, while density and height of its principal competitors are markedly reduced. Clatterbuck (1997) found that three burns at three-year intervals in a slash pine plantation helped develop advance oak regeneration and limited the amount of yellow poplar.

Brose, *et al.* (1997, 1999) and Brose and Van Lear (1998) studied a shelterwood-burn technique for regenerating productive upland-oak sites and found that oak regeneration is more resistant to surface fires than its primary competitors if burning occurs three to five years after a partial overstory harvest. They suggest that this combination of cutting followed by fire mimics natural disturbances that have occurred in eastern North America for thousands of years. One year following prescribed fire and overstory thinning, Rebbeck *et al.* (2004) found that a single, low-intensity, dormant-season burn is not sufficient to remove larger, non-desirable species such as maple, and that more aggressive measures, such as repeated, higher-intensity fires, combined with herbicide treatments, may be needed. Also, following thinning and prescribed fire, Long, *et al.* (2004) found no difference in height or diameter growth for red oak sprouts, while white oak sprouts were significantly larger in height and diameter with thinning and burning. To avoid damage to residual overstory trees, Brose and Van Lear (1999) suggest that prescribed fires be carefully planned and executed in shelterwood stands because of the logging slash.

In reviewing the effects of repeated prescribed fires on the structure, composition and regeneration of mixed-oak forests, Hutchinson, *et al.* (2005) found that the application of fire alone, without partial harvesting, failed to improve oak regeneration consistently, but the longer-term application for fire may be a feasible strategy for improving the sustainability of oak forests where harvesting is not permitted. At the Land Between the Lakes in western Kentucky, just south of the Forest, Franklin, *et al.* (2003) found that burning did not affect stems greater than 3.8 centimeters diameter at chest height, and that thinning of the canopy was generally necessary for the understory to respond to burning treatments.

Although fire played a major role in upland-forest dynamics prior to settlement, structure and composition can no longer be maintained by fire. Succession without fire has resulted in a different structure and composition of oak forests, altering both fuels and fuel-moisture levels (Franklin, *et al.* 2003). Abrams (2005) questions whether time is running out for the implementation of prescribed fire in eastern oak forests, because the conversion of flammable oak litter in forest understories to less combustible and more-rapidly decomposed litter of mixed-mesophytic and, later, successional tree species is rendering eastern forests less prone to burning. Thus, forest managers wishing to restore historical burning regimes to eastern forests in hopes of encouraging more oak regeneration, while reducing native invasive tree species, should act sooner rather than later, as the window of opportunity may be closing in the foreseeable future (Abrams, 2005).

Prescribed fire would vary by alternative (see Table 3-13). Burning for site-preparation/ brush disposal would be done near the time of timber harvest to help create conditions favorable to oak-regeneration, reduce logging-slash and control understory competition from more shade-tolerant species. The use of fire for landscape-scale, hardwood-site preparation is prescribed for large blocks of forestland to mimic natural fire regimes and help maintain the oak-hickory forest-type through control of the more-mesic species in the forest understory. Burning for ecological purposes is prescribed for natural areas to help in the maintenance of the barrens natural communities and would occur approximately three times per decade. Large-openland management would utilize prescribed fire to help maintain the openland habitats.

Table 3-13. Acres (x 1,000) of prescribed fire in first decade under each alternative.

Type of Burn	Alt. 1	Alt. 2	Alt. 3	Alt. 4
Site preparation/brush disposal	11	17	0	14
Landscape-scale hardwood site preparation	5	66	0	65
Ecological – natural area barrens	30	30	30	30
Large-openlands management	11	11	0	11
Total	57	124	30	120

As shown earlier, the number of acres burned per year has varied based upon differences in weather, the number of fire-starts, fuel-types and other variables. The selected alternative could have indirect effects on the acreage burned in the future based upon differences in access, acres treated for specific management objectives and other factors. Since there is no way to directly predict all the factors that contribute to the acreage burned per year by wildland fires, there is no method to predict how the pattern of fires will vary between alternatives.

Existing roads and trails are used for access to areas scheduled for prescribed fire and as control-lines during burning. Administrative use of motorized vehicles on trails or closed roads could occur during prescribed fire. Construction of new roads to implement prescribed fire is not anticipated. In some cases, system roads may be closed temporarily if smoke reduces sight-distance or otherwise creates a hazard to the public. Smoke from prescribed fire could affect traffic on non-system roads for short periods of time.

Under any alternative, the miles of system roads would be similar. However, no roads would be reconstructed for timber access under Alternative 3, so access for prescribed fire, fire use and wildfire suppression would be more difficult under this alternative than the others.

a. Alternative 1

The beneficial, direct and indirect effects of prescribed fire on forest ecosystem health and sustainability under Alternative 1 would be similar to Alternatives 2, 3 and 4 with respect to ecological burning for the maintenance of barrens in natural areas. The beneficial, direct and indirect effects of burning for large openland management would be similar to Alternatives 2 and 4 and better maintain large openland habitat than Alternative 3. Alternative 1 allows only limited landscape-scale burning and thus would provide limited beneficial, direct and indirect effects related to hardwood site-preparation or control of maple-beech stems in the understory.

b. Alternatives 2 and 4

Implementation of Alternatives 2 and 4 would result in greater, beneficial, direct and indirect effects related to sustaining forest ecosystem health and maintaining more of the oak-hickory forest type than would Alternatives 1 and 3. This would result by implementing large, landscape-scale, prescribed fire to mimic natural fire-regimes that would maintain the oak-hickory forest-type through control of the more-mesic species in the forest understory. Burning under these alternatives would result in similar effects as under Alternatives 1 and 3 regarding the maintenance of barrens communities in natural areas. They would result in more beneficial, direct and indirect effects of maintaining large-openland habitats than would Alternative 3, similar to Alternative 1 in the management of large openlands.

c. Alternative 3

Alternative 3 allows limited prescribed fire in natural areas for the maintenance of barrens communities and threatened, endangered and sensitive species, with beneficial, direct and indirect effects on these communities and species. No other burning is prescribed and, thus, this alternative would result in adverse, direct and indirect effects on the maintenance of the oak-hickory forest-type and large-openland habitats.

9. Integrated Pest Management

a. Insects and Pathogens

i. Alternatives 1, 2 and 4

Under these alternatives, insects and pathogens occurring on the Forest would be managed by isolating and treating infected areas as soon as possible after the infecting agent is discovered. With the cooperation of other agencies, care is taken to identify problems and treat areas quickly with appropriate tools. Implementation of these alternatives would result in the beneficial, indirect effect of promoting a more vigorously growing forest of varying age-classes that should be more resistant to insects and pathogens.

ii. Alternative 3

This alternative would promote old-growth forest over the long term, with no timber harvest allowed. Tree-vigor would be less than under the other alternatives due to the natural weakening of older trees. Control of insects and pathogens would be more difficult since chemical methods of control would not be allowed. This would result in less beneficial, indirect effects on forest health than the other alternatives.

b. Non-native Invasive Species

i. Alternative 1

Alternative 1 allows the control of non-native invasive species in natural areas and wilderness, including the use of prescribed fire, but has no specific direction in other management prescriptions. Although the control of non-native invasive species in natural areas and wilderness would help with some of the most sensitive areas on the forest, problems are more likely to occur and not be controlled in other areas. Implementation of Alternative 1 would result in the beneficial, direct and indirect effects of non-native invasive species control in more areas of the Forest than Alternative 3; but it would not be as beneficial and effective as under Alternatives 2 and 4.

ii. Alternatives 2 and 4

Alternatives 2 and 4 include standards and guidelines for the control of non-native invasive species, allowing such practices as prescribed fire, cutting, pesticide-application, mowing, biological control and/or manual removal. Manual or mechanical controls include methods such as hand-pulling, cutting, tree-girdling, mowing, tilling, scorching with a propane torch and prescribed fire. These methods are usually benign in that they target specific weeds and do no harm to desirable plants. They may not be effective if weed infestations are extensive.

Biological controls include the release of insects or pathogens that damage the target organism, the planting of other species that compete well with the invasive plant and the use of grazing. Biological-control agents are available and approved for only a few of the invasive plants in North America, but are more commonly used to control unwanted insects. Chemicals are very effective in controlling non-native invasive species and generally would be used when other methods are not practical or feasible.

Because standards and guidelines stipulate control measures Forest-wide, implementation of Alternatives 2 and 4 would have the more beneficial, direct and indirect effects that result from a higher level of control of non-native invasive species than would the other alternatives. However, complete control of all problem species is not anticipated since such control is likely not possible.

iii. Alternative 3

Alternative 3 allows the use of only mechanical and manual methods of control, including the burning of individual plants and limited biological control. This alternative would be less effective in controlling persistent species that are difficult or impossible to eliminate without the use of chemicals. Implementation of this alternative would thus have the adverse, direct and indirect effects of allowing continued problems with non-native invasive species on more acres than the other alternatives.

10. Openings and Openlands Management

The direct effects of openings and openlands management on forest health and the timber resource are simply that an open tract of land is not in a forested condition. The methods of management would have minimal direct or indirect effects under any alternative. Alternatives 1 and 4 would produce the highest acreage of openings and openlands and, therefore, contribute somewhat less forested acreage than the other alternatives. Alternative 2 would maintain the same acreage of openlands as Alternatives 1 and 4, but less than one-third of the wildlife openings. Under Alternative 3 all openings would be reforested, creating more forested habitat.

11. Aquatic Resources Management

No effects on forest ecosystem health and sustainability are anticipated.

12. Minerals Management

The direct and indirect effects of minerals management on forest health and the timber resource are directly proportional to the amount and type of surface occupancy that could occur under each of the alternatives. Surface occupancy would cause the displacement of trees by roads, drill rigs, well-pads and settling ponds.

a. Alternative 1

Alternative 1 identifies some areas on the Forest as suitable for oil and gas exploration and development with standard stipulations. Other areas of the Forest are identified as suitable with special stipulations and some areas are withdrawn from exploration and development. Of the four alternatives, this alternative could have the greatest potential for surface occupancy and, therefore, the greatest, adverse direct and indirect effects on the forest resource.

b. Alternative 2

This alternative designates the federally owned mineral estate beneath wilderness as not available for oil and gas leasing and applies no-surface-occupancy stipulations to special areas. This decrease in the area available for surface occupancy would result in less adverse, direct and indirect effects on forest health and the timber resource than under Alternative 1.

c. Alternative 3

Alternative 3 identifies the federal mineral estate as unavailable for leasing. There would be no surface occupancy under this alternative and, so, no direct or indirect effects on forest health or the timber resource.

d. Alternative 4

This alternative applies no-surface-occupancy stipulations Forest-wide. For this reason, there would be no direct or indirect effects on forest health or the timber resource.

13. Land-Ownership Adjustment

Under any of the alternatives, the direct or indirect effects of land-ownership adjustment on forest health and the timber resource are directly related to the amount of acquisition and exchange that takes place and the condition of the forest and timber resource on the acquired and exchanged lands. Because the alternatives do not dictate a schedule for acquisition or exchange, no effects can be anticipated at the programmatic level.

CUMULATIVE EFFECTS ON FOREST ECOSYSTEM HEALTH AND SUSTAINABILITY

This discussion of cumulative effects takes into consideration the past, present and reasonably foreseeable future actions specified at the beginning of Chapter 3, principally those discussed below.

Past and present activities on and around the Forest have influenced forest ecosystem health and sustainability and have had the effect of creating the forest ecosystem that exists today. This ecosystem is much less extensive than the one that existed in pre-settlement times (Bretthauer and Edgington, 2002), but research indicates that pre-settlement witness-tree patterns largely reflect present-day patterns and frequencies of overstory trees (Fralish *et al*., 2002; Fralish *et al*., 1991; McArdle, 1991; Helmig, 1997). With the exception of non-forested areas and non-native pine plantations, oak-hickory forest is dominant today in most of the same places where it was dominant in pre-settlement times.

One of the principal elements that can affect forest ecosystem health and sustainability is fire, including wildfires and intentionally ignited fires, both prehistoric and historic. Wildfires and fires ignited by Native Americans, together with seasonal tornadic windstorms, helped maintain the predominantly oak-hickory forest that was present prior to European settlement. It is estimated that windstorms can affect about one percent of the forest area per decade, based on information presented in Rebertus and Meier (2001). Fires ignited by early settlers, together with large-scale timber harvesting and other disturbances, such as grazing, helped create the conditions re-establishing the oak-hickory forest of today.

Fire-control measures and the lack of other disturbance over the last 75 years have resulted in conditions unfavorable to the regeneration of oak, allowing shade-tolerant, fire-intolerant maple and beech to become established in the understories and mid-stories of the oak-hickory forest that was established in the late 1800's and early 1900's. The maple and beech in the understories and mid-stories then are able to grow into the overstories as the oaks and hickories die or are removed.

The past, broad-scale clearance of forests for the establishment of homesteads, agriculture and residential developments have reduced the amount of land available for forest ecosystem habitat and growth. The amount of land for sustainable forests has also been reduced by the construction and maintenance of roads and trails, powerlines, wildlife openings, reservoirs and ponds, levees, railroad grades and recreation facilities, as well as by past and present mining—primarily open-pit coal-extraction.

The establishment of the Forest involved the purchase of old farms in the 1930's, '40's and '50's. Planting old farm-fields in pine trees for the control of soil erosion resulted in the reforestation of about 45,000 acres in non-native pine plantations. The federal acquisition of land in southern Illinois has led to the management of about 284,000 acres for multiple uses, including the maintenance of healthy forest ecosystems and the management of timber resources.

Past timber harvests on the Forest have included clearcutting and group-selection in hardwood-stands and shelterwood and thinning in pine-stands. Harvesting on privately owned land has often been done using a diameter-limit cut in which the bigger and better trees are removed, leaving smaller trees of less-desirable species. Pine shelterwood and thinnings on the Forest have aided the establishment of native hardwoods in the understories of some non-native pine plantations. While clearcutting and group-selection have established some younger, hardwood stands in the last 30 to 40 years, the percentage of seedling/sapling-size stands has decreased from 13 percent in 1985 to three percent in 1998 (Haugen, 2003), due primarily to recent reductions in timber harvesting on the Forest. Most of the trees on the Forest continue to mature and many are becoming over-mature and dying of old age.

Timber harvesting continues to occur on private lands. Based on the 1998 Forest Inventory and Analysis data, the amount of timber harvested from private lands in the counties of the planning area has been over four times the amount harvested from national forest land. Regardless whether timber is harvested on private or public land, removing an oak-hickory overstory without adequate, advanced oak-hickory regeneration will likely convert the stand to the more shade-tolerant species that are growing in the understory, particularly on better sites. Wildfire suppression during the last 75 years and reductions in other types of disturbances, such as grazing and timber harvesting, have also allowed the more-shade-tolerant species, including maple and beech, to grow up under predominantly mature oaks and hickories in many parts of the Forest.

Tree-planting and timber-stand improvement projects, including the use of herbicides to reduce vegetative competition, have been used to help promote desirable species composition and growth. The introduction and establishment of non-native invasive species, through intentional plantings or their inadvertent spread by humans and animals, have reduced biodiversity and ecosystem health in many places by competing with and eliminating native plant species.

Wilderness designation and management, along with other management prescriptions that restrict timber harvest, has reduced the amount of land considered suitable for timber management. This has promoted a more mature forest with fewer stands of younger ages and less land available for sustainable forest-growth and production.

Agricultural practices and the maintenance of road and powerline rights-of-way have involved, and continue to involve, the use of pesticides. The IDNR Critical Trends Assessment Project states that by the early 1990's more than 96 percent of all cropland in Illinois was treated for weeds at least once each year (www.dnr.il.us/orep/ctap/sumrepo/chap8). In the counties of the planning area, this represents the treatment with herbicides of about 793,000 acres of cropland each year, an area nearly three times the total acreage of the Forest.

The past and present activities discussed at the beginning of this chapter have produced the existing forest-ecosystem condition upon which the reasonably foreseeable future actions will have additional effects. Reasonably foreseeable future actions on and around the Forest include the actions and activities proposed in the Plan-revision alternatives and actions that might occur on other ownerships. Most of the present actions occurring around the Forest, such as agriculture; pesticide use; the maintenance of roads, railroads, powerlines and reservoirs; residential developments and mining will continue in the future. These activities will generally not affect forest health and sustainability to any greater degree than at present, unless additional forested areas are reduced. Because most owners of private forests are not managing their forests to maintain the oak-hickory forest type, timber harvesting on privately owned land will likely affect forest health by hastening the conversion to the maple-beech forest-type.

1. Alternative 1

Management under Alternative 1 would continue the conversion of the oak-hickory forest-type to the maple-beech type in restrictively managed areas. Under this alternative, the implementation of a moderate prescribed-burning program, group-selection harvesting, tree planting where oak-hickory regeneration is lacking and timber-stand improvement would support a greater percentage of the oak-hickory forest-type than would occur if no actions are taken. The conversion of non-native pine plantations to native hardwoods, including oaks and hickories, would enhance the natural biodiversity and health of the forest within a shorter timeframe than under Alternative 3.

Management of the forest to maintain vigorous growth would support conditions that limit and/or prevent insect and pathogen problems. The limited control-options allowed under this alternative for non-native invasive species could improve forest health, but not to the extent of Alternatives 2 and 4. Considered together with the effects of past, present and reasonably foreseeable future actions on and around the Forest, implementation of Alternative 1 is expected to result cumulatively in a forest ecosystem that is less healthy than might occur under Alternatives 2 and 4, but generally healthier and more sustainable than what would occur under Alternative 3.

2. Alternative 2

Management under Alternative 2 would continue the conversion of the oak-hickory forest-type to the maple-beech type in restrictively managed areas. However, under this alternative, the implementation of a landscape-scale, prescribed-burning program, shelterwood harvesting, tree planting where oak-hickory regeneration is lacking and timber stand improvement would support a greater percentage of the oak-hickory forest-type than would occur if no actions are taken. The conversion of non-native pine plantations to native hardwoods, including oaks and hickories, would enhance the natural biodiversity and health of the forest within a shorter timeframe than under Alternative 3.

Management of the forest to maintain vigorous growth would support conditions that limit and/or prevent insect and pathogenic problems. The aggressive control of non-native invasive species allowed under this alternative would improve forest health to a greater extent than under either Alternative 1 or 3. The amount of possible herbicide use on the Forest would be minuscule when compared to the use on croplands and road and powerline rights-of-way. For instance, if every acre of proposed timber-stand improvement were treated with herbicide in the first decade (an extremely unlikely possibility), the area affected would represent only .07 percent of the acreage treated for agricultural purposes in the eleven counties of the planning area.

Considered together with the effects of past, present and reasonably foreseeable future actions on and around the Forest, implementation of Alternative 2 is expected to result cumulatively in a forest ecosystem that is healthier and more sustainable than might occur under Alternatives 1 and 3, but similar to Alternative 4.

3. Alternative 3

The generally restrictive management proposed under Alternative 3 would limit the amount of disturbance allowed in the forest ecosystem and encourage the continued conversion of the oak-hickory forest-type to the maple-beech type across most of the Forest, except on areas of shallow soils and low site-productivity. The restrictive management proposed under Alternative 3 would allow no timber harvesting, no landscape-scale, prescribed fire and no timber-stand improvement activities, all of which are necessary for oak-hickory regeneration and growth.

The conversion of non-native pine plantations to native hardwoods would be delayed under Alternative 3, since the elimination of the pine overstory would depend on natural mortality only. Management under Alternative 3 would result in the creation of a mature, old-growth forest across the landscape. It would not maintain the vigorous forest-growth necessary to prevent insect and pathogen problems; but, rather, would create the conditions that predispose the forest to destructive outbreaks of these problems.

The less-aggressive control of non-native invasive species permitted under Alternative 3 would allow non-native invasive species to continue to be a problem and, so, have adverse effects on the health of the forest ecosystem. The reforestation of all openlands, together with the lack of openlands management, would increase the amount of forested land on the Forest by about one percent and have a minor, positive affect on forest health and sustainability. The management of roads and trails, minerals management and land-ownership adjustment would have minimal cumulative effects on forest health and sustainability when compared to the effects of activities that directly affect forest vegetation.

Considered together with the effects of past, present and reasonably foreseeable future actions on and around the Forest, implementation of Alternative 3 is expected to result cumulatively in a mature, old-growth forest ecosystem, with much of the Forest dominated by the maple-beech forest type, predisposed to outbreaks of destructive insects and pathogens and with continued non-native invasive species problems. The future forest ecosystem would not be as biologically diverse and, therefore, would not be considered as healthy and sustainable as the forest ecosystems resulting from Alternatives 1, 2 and 4.

4. Alternative 4

Management under Alternative 4 would continue the conversion of the oak-hickory forest-type to the maple-beech type in restrictively managed areas. However, under this alternative, the implementation of a landscape-scale, prescribed-burning program, shelterwood-harvesting with reserves, tree planting where oak-hickory regeneration is lacking and timber stand improvement would support a greater percentage of the oak-hickory forest-type than would occur if no actions were taken. The conversion of non-native pine plantations to native hardwoods, including oaks and hickories, would enhance the natural biodiversity and health of the forest within a shorter timeframe than under Alternative 3.

Management of the forest to maintain vigorous growth would support conditions that limit and/or prevent insect and pathogen problems. The aggressive control of non-native invasive species allowed under this alternative would improve forest health to a greater extent than under either Alternative 1 or 3. Considered together with the effects of past, present and reasonably foreseeable future actions on and around the Forest, implementation of Alternative 4 is expected to result cumulatively in a forest ecosystem that is healthier and more sustainable than might occur under Alternatives 1 and 3 and similar to Alternative 2.

D. BIODIVERSITY

Biodiversity, simply stated, is the variety of life and living things and the many processes associated with them. It is the plants and animals and their biological communities and ecological associations, or ecosystems. Biodiversity encompasses genetic diversity and variation, species diversity, community and ecosystem diversity and geographical or landscape diversity.

Genetic diversity refers to the levels of genetic variation within and among populations. Species diversity refers to the numbers and distributions of species that contribute to both natural genetic variation and the likelihood of continued existence throughout their geographic ranges in the long term.

Community and ecosystem diversity refers to the compositional, structural and functional variety of communities and ecosystems. Landscape diversity refers to the variety of the kinds of biological communities and a biogeography (patterns, sizes, shapes, juxtapositions and interconnectedness) that provides a free and natural interchange of individuals throughout the area. The biogeography required to sustain migratory species in viable numbers and distributions involves very large wildland areas, or bioregions.

The SNF, working cooperatively with the Hoosier National Forest, its neighbor in Indiana, undertook an evaluation of the ecological conditions on both Forests. The *Hoosier-Shawnee Ecological Assessment* (Assessment) (2004) describes the ecological conditions and resources—including soils, forest-types, native plant communities, aquatic resources, wildlife, fish and aquatic invertebrates, pathogens and insect pests and exotic plants and animals—that make up the biodiversity of the Forest. The Assessment provides an essential basis for providing for the diversity of plant and animal communities on the SNF (see 219.26) and for establishing the coarse- and fine-filter approach of conserving biodiversity.

This discussion of biodiversity is divided in two parts. Part One describes the ecological communities and habitat-types important to the maintenance of biodiversity and the viability of the majority of the plant and animal species native to the Forest and analyzes the effects on them of Forest management and use. Part Two describes individual species of various ecological areas of the Forest, many of which have some degree of population-viability risk on the Forest and analyze the effects on them of Forest management and use. The analysis in Part One of the effects on ecological communities and habitats can be considered a "coarse-filter" analysis and the analysis in Part Two of the effects on the species at risk can be considered a "fine-filter" analysis.

PART ONE: ECOLOGICAL COMMUNITIES AND HABITAT-TYPES

1. ECOLOGICAL DIVISIONS

The SNF is located in an upland area of southern Illinois that remained unglaciated for the most part during the last ice age. Physiographically, most of the Forest lies within the Shawnee Hills section of the Interior Low Plateau Province; portions at the western and southern margins are in the Ozark Highlands section and Upper Gulf Coastal Plain section (Ponder, in the *Hoosier- Shawnee Ecological Assessment*, 2004). Slopes are moderately steep, averaging 25 to 30 percent; but topographic relief seldom exceeds 300 feet. The Forest consists of three ecological sections (Ponder, 2004): the Greater Shawnee Hills, the Upper Gulf Coastal Plains and the Ozark Highlands.

a. Shawnee Hills Section

This section extends across southern Illinois from Fountain Bluff in the Mississippi River valley to the Shawneetown Hills overlooking the confluence of the Wabash and Ohio Rivers and includes the Lower Ohio-Wabash Alluvial Plains. The section is distinguished by a scenic east-west escarpment of sandstone cliffs—the Greater Shawnee Hills subsection—and a series of lower hills underlain by limestones and shales capped with sandstone—the Lesser Shawnee Hills subsection. The alluvial plains of the lower Wabash and Ohio Rivers subsection contains the bottomland forests in floodplains of both rivers. Prior to European settlement, the Shawnee Hills were dominated by upland forests, much of which remains forested and by bottomland forests in the Wabash and Ohio Rivers floodplains, most of which are regenerating today.

i. Greater Shawnee Hills Subsection (47 percent of the Forest)

The "backbone" of the SNF, this section's most distinguishing features are the parallel series of southerly-facing cuestas—ridges with a gentle (dip) slope on one side and a steep slope on the other. The highest elevations and the deepest canyons are found here. Deep ravines, sandstone ledges and shelter-bluffs located along the larger creeks and streams provide habitat for more northerly-acclimated plants, such as clubmosses, cinnamon fern, barren cliff strawberry and American barberry. The Pennsylvanian-age sandstone escarpments contain the Midwest's most diverse and highest-quality system of sandstone barrens and dry oak woodlands.

ii. Lesser Shawnee Hills Subsection (21 percent of the Forest)

Located south of the Greater Shawnee Hills, the Lesser Shawnee Hills are distinguished by a series of parallel cuestas oriented to the southeast rather than the south. These cuestas are not massive sandstones; they are, rather, limestones and shales capped with thinner sandstones. Stream valleys and floodplains here are broad, the result of the backwaterdeposition of glacial outwash carried two hundred miles south by meltwaters of the Wisconsinin glaciers 10,000 years ago. Some of this terrain is characterized by sinkholes. Here the grassland flora of the southeast take hold on the limestone barrens that provide habitat for such rare species as climbing milkweed, crested coralroot orchid and blue sage.

iii. Lower Ohio-Wabash Alluvial Plain Subsection (1 percent of the Forest)

This subsection is comprised of the bottomlands of the Wabash River and that portion of the Ohio River north of its confluence with the Saline River. It is characterized by extensive tracts of bottomland forest, sloughs, marshes and oxbows in the floodplains of the rivers and their tributaries.

b. The Upper Gulf Coastal Plains Section

The northernmost extension of the Gulf Coastal Plain, this section encompasses the alluvial plains of Bay Creek and the Cache, Ohio and Wabash Rivers—the Ohio and Cache Rivers Alluvial Plain subsection—and the hills composed of Cretaceous and Tertiary sands, gravels and clays—the Cretaceous Hills subsection.

i. Ohio and Cache River Alluvial Plain Subsection (2 percent of the Forest)

This subsection is characterized by bald-cypress–tupelo swamps and extensive bottomland forests with southern affinities. Its extent on the Forest is limited and is best exemplified by the Grantsburg and Reeseville swamps.

ii. Cretaceous Hills Subsection (3 percent of the Forest)

This subsection is located south of the ancestral Ohio River channel (now known as the Cache Valley) and composed of low, clay and gravel hills deposited on terraces above glacial Lake Cache that was formed in the valleys of the Cache and Ohio Rivers. Within this section were located the Big Barrens of Pope and Massac counties: large brushy grasslands dominated by warm-season grasses and containing the floristically-unusual acid-seep springs and the extremely rare mesic barrens that occurred on sandy terraces along streams.

c. The Ozark Highlands Section

This section consists of the Illinois portion of the Salem Plateau, part of the Ozark Uplift centered in the St. Francois Mountains in east-central Missouri and the Mississippi River Alluvial Plain. The Illinois Ozarks portion of this section is generally forested, with excellent examples of limestone barrens and cliff communities and characterized by many Ozarkian, southern and southwestern plants otherwise rare in Illinois. The Mississippi River Alluvial Plain historically was heavily forested with bottomland species and included many forested wetlands, but is now dominated by intensive agricultural use.

i. Illinois Ozarks Subsection (19 percent of the Forest)

This subsection borders the Mississippi River Alluvial Plain on the west. Massive Devonian-age chert and limestone cliffs meet the bottomlands along its western border. The hills are extremely steep and dissected by deep ravines. The area is floristically distinguished by southern and Ozarkian flora, such as black spleenwort, azalea, cucumber magnolia and shortleaf pine.

ii. Mississippi River Alluvial Plain Subsection (8 percent of the Forest)

This subsection is comprised of the Mississippi River and a broad floodplain that resulted from glacial outwash. The area is floristically composed of species with northern and southern affinities and dominated by bottomland forests, marshes and wet prairies. It was once characterized by extensive tracts of bottomland forest, swamps, bayous and oxbows formed by slack-water deposits at the end of the last glacial age.

2. NATURAL COMMUNITIES AND HABITATS

a. Barrens

Barrens are complex natural communities owing their fragile existence to a delicate balance of natural forces that prevent their succession to a forest community. Barrens—including hill prairies and glades—are characterized by dual, dominating components, the herbaceous layer, composed of both dry-forest and dry-prairie grass and forb species and a woody overstory composed of scattered, stunted, limby oaks and hickories. Vines are commonplace. Lichens and mosses are found scattered among the grasses and forbs. Patches of bare ground and exposed rock often contribute to unstable soil-surface conditions. The soils are generally droughty, usually highly leached, alkaline or acidic, rarely neutral, eroded and often deficient in certain minerals or nutrients.

Barrens are among the rarest of Midwestern natural communities. In the absence of periodic fire, they soon succeed into dry-upland forests. Even though grazing or tilling has eliminated many of these communities, some are now located where native barrens vegetation has re-colonized disturbed areas. Given proper management and time, these natural communities can be restored. White (2004) presents an anthology of papers about wildland fire, barrens and glades in the Shawnee Hills, which supports the need for, and describes the positive effects of, fire management on the Forest.

The Forest contains representatives of nine types of barrens. These include the loess (dry-mesic) barrens of the Cretaceous Hills, Greater and Lesser Shawnee Hills and Illinois Ozarks subsections; the gravel barrens of the Cretaceous Hills and Illinois Ozarks subsections; and the sand barrens and limestone barrens of the Greater and Lesser Shawnee Hills and Illinois Ozarks subsections. See Forest Plan Appendix D for descriptions of these barrens and the dominant plant species associated with them.

Today there remain on the Forest only 2,700 acres of barrens habitats. This includes the high-quality barrens in natural areas, as well as those of lesser quality in other management areas. This is far less than the 20,000 to 30,000 acres of historical barrens (Hutchison *et* *al.*, 1986) within the Cretaceous Hills subsection alone. Lack of natural disturbances, primarily fire, has allowed many historical barrens to succeed to upland forests over the last 100 years.

Table 3-14. Barrens by ecological subsection, managed since 1987 to maintain diversity.

Greater Shawnee Hills	Lesser Shawnee Hills	Cretaceous Hills	Illinois Ozarks
Cave Hill	Barker Bluff	Burke Branch	Atwood Ridge
Crow Knob	Copperous Branch	Cretaceous Hills	Ozark Hill Prairies
Fink Sandstone	Keeling Hill North	Dean Cemetery East	LaRue-Pine Hills/Otter Pond
Gibbons Creek	Keeling Hill South	Dean Cemetery West	Opossum Trot Trail
Stoneface	Leisure City	Dog Barrens	Pine Hills Annex
	Pleasant Valley	Kickasola Cemetery	
	Russell Cemetery	Poco Cemetery North	
	Simpson Township	Poco Cemetery East	
	Whoopie Cat Mountain	Robnett Barrens	

From the late 1980's to the late 1990's, the Forest managed 28 barrens (Table 3-14) with fire and/or tree- and shrub-cutting/removal to maintain open, barrens conditions. However, since then, most of this management has stopped, pending additional project-planning efforts. In the absence of regular fire management, many of these once-managed barrens are reverting quickly back to upland forest. The degree of prescribed fire and vegetation treatments to maintain barrens habitats are issues that affect these communities and their associated species.

b. Forests

Forests are communities dominated by trees; that is, they have an overstory or canopy-cover of 80 percent or more. They are divided into three subclasses, two of which are defined by their topographic position—upland and floodplain. The third is flatwoods, which can occur at any topographic position depending on the soil structure. Flatwoods are not common on the Forest.

Upland forests normally do not flood. They occur not only on typical uplands, but also on stream-terraces because terraces normally do not flood. Floodplain forests are distinct from the upland because of flooding, which affects both the biotic and abiotic features of the community. Upland and floodplain forests are further subdivided by soil-moisture gradients—xeric, mesic and wet-mesic.

Seventy percent of the SNF is dominated by these native forest communities and they occur in all of the ecological subsections on the Forest. Presently, most of the upland-forest communities are dominated by oak species. (See Forest Plan Appendix D for descriptions of these forest communities and the dominant plant species associated with them.) The amounts of mature and old-growth forest, of oak-hickory-dominated forest, and of early-successional forest are factors affecting these community-types and their associated species.

Mature hardwood forests are vitally important as habitat for forest-interior species and in determining the vigor of oak-hickory forests, key issues for the Forest. Early-successional forests are vital to maintaining the vigor of oak-hickory forests and early-successional wildlife species dependent upon them, also key issues for the Forest.

Deciduous forests dominated by oaks and hickories produce hard seeds, called nuts and hard mast. These hard-mast food-sources in oak-dominated forest communities are available to many native wildlife species as high-energy foods during dormant seasons when green growth is absent.

c. Woodland

"Woodland" is a natural-community class unrecognized by many community ecologists in Illinois and was not included in the Illinois Natural Areas Inventory's "Classification of Natural Communities in Illinois," where most examples of woodland were classified as either dry barrens or dry-upland forest. Woodland is defined here as a community dominated by trees and grass and/or forbs. The mean-average potential height of trees is usually 50 feet. The shapes of woodland and forest trees, even of the same species, differ from one another. Woodland trees have highly-branched trunks with spreading limbs, while forest trees are relatively narrow with few low branches. The woodland canopy, which can be very open, is generally interrupted and has an average closure of 30 to 80 percent. Young trees or shrubs are sparse in the understory. The herbaceous layer is dominated by grasses and forbs commonly associated with barrens or dry-upland forest. Fire is of great importance; in fact, the open nature of the woodland is dependent upon it.

Presently, it is estimated that only about 10,000 acres, or about four percent of the Forest—primarily in natural areas—are of the woodland community. This could change, depending on the extent to which prescribed fire is applied in oak-dominated forests on south and southwest aspects in all ecological subsections and in oak-dominated bottomland forests. (See Forest Plan Appendix D for descriptions of woodland communities on the Forest and the dominant plant species associated with them.)

d. Cliffs, Rock Outcrops, Caves

Cliff and rock-outcrop communities and habitats form on vertical exposures of resistant bedrock and are found in all ecological subsections on the Forest. Most cliff flora develop in accumulations of soil in small crevices and on ledges. Variations in plant and animal life are due to different rock characteristics, aspects and soil moisture that are a result of shading from adjacent forests. In general, north- and east-facing slopes support vegetation that is more lush and more diverse. Sandstone and limestone cliffs and overhangs are the predominant community-types on the Forest. (See Forest Plan Appendix D for descriptions of cliff communities on the Forest and the dominant plant and animal species associated with them.)

Historically, disturbances of these communities are from recreational activities, and some quarrying in limestone areas. However, native fauna and flora continue to occur in most areas. Current disturbances are mainly from unauthorized recreational activities. The most-diverse cliff communities are located in 28 natural areas managed to perpetuate their diversity.

Cave communities are of two types, terrestrial and aquatic. They have been disturbed by recreational uses and some mining and/or quarrying; however, most remain intact ecologically, with native fauna such as bats and invertebrates. Most are located in the Greater and Lesser Shawnee Hills and Ozark Hills ecological subsections. Generally, they are features in limestone, with most portions not penetrated by sunlight. (See Appendix D for descriptions of cave communities on the Forest and the dominant plant and animal species associated with them.) Caves are managed to maintain their biodiversity by their inclusion in seven natural areas and by Forest-wide standards and guidelines. The degree of unauthorized or unrestricted recreation associated with cliff and cave communities is a major factor affecting the communities and their dependent species.

e. Wetlands (Aquatic)

Wetland communities include springs and seeps, swamps and natural ponds. Spring and/or seep communities and habitats are found throughout the Forest; however, there is little information on the hydrology and biology of these habitats (Whiles and Garvey, 2004). (See Forest Plan Appendix D for descriptions of spring, seep and open-water communities on the Forest and the dominant plant and animal species associated with them.) Seeps are concentrated in the Cretaceous Hills ecological subsection and springs primarily in the Greater and Lesser Shawnee Hills and Ozark Hills subsections. Many of the largest springs and rarest seeps are included in natural areas and managed for their protection. All are protected to some extent by Forest-wide standards and guidelines.

Historical disturbance of springs and seeps was associated with farmstead activity and agriculture. Present-day disturbances of these communities and habitats are associated generally with unauthorized dispersed recreational uses. Natural-area management, including the degree to which prescribed fire and vegetation treatments are allowed, as well as unauthorized recreation, are major factors affecting these communities and their dependent species.

Most of the Forest is comprised of upland communities typical of the Greater and Lesser Shawnee Hills, Illinois Ozarks and Cretaceous Hills subsections. Only a few wetland communities, primarily swamps and natural ponds, are known to occur in the bottomlands within the Ozark Highlands and Upper Gulf Coastal Plain sections, within the alluvial plains. (See Appendix D for descriptions of these wetland communities and the dominant plant species associated with them.)

Historically, the greatest effects on these swamps were caused by drainage for agriculture (Whiles and Garvey, 2004). Today, the largest and most diverse swamps are managed as natural areas to promote the long-term diversity of these remnants. Swamp communities will increase on the Forest, primarily in the Mississippi River Alluvial Plain subsection, as additional former cropfields are acquired and restored to wetlands. The restoration of wetlands and bottomland forests, and the degree to which vegetation treatments are allowed to accomplish that restoration, are issues affecting these communities.

Open-water, aquatic communities include streams, ponds and lakes or reservoirs. More than 150 miles of perennial streams and 700 miles of intermittent streams include all the stream communities and habitats on the Forest. A few, rare, aquatic animals and plants occur in some of these streams (Burr *et al.*, 2004). Stream communities and habitats occur throughout all of the ecological subsections on the Forest.

Because SNF land was originally privately owned, severely eroded farmland and because ownership today is generally fragmented, with the intermingling of myriad private and public activities, all streams have been affected to some degree by human activities. Currently, as historically, the greatest threats are from non-point agricultural runoff, urbanization, industrial activities such as mining and non-native invasive species (Whiles and Garvey, 2004).

Reservoirs are cultural, wetland communities that include dammed, perennial or intermittent streams. On the Forest there are fifteen reservoirs or lakes over ten acres in size, and 40 to 50 small, walk-in reservoirs/ponds that are managed in cooperation with the IDNR for recreational fishing. There are many more, small waterholes/reservoirs not actively managed for recreational fishing. These provide aquatic habitats for many of the forest amphibians. The managed reservoirs provide nearly 7,500 acres of surface water.

Current and past management has included periodic fish-population management, including stocking and population reduction of some species, drawdowns, population counts, aquatic-weed control, dam and boat-launch construction and maintenance, pond dam and bank management, and protection from soil and water-quality disturbances by Forest-wide standards and guidelines. Agricultural runoff from private lands in the watersheds has had and continues to have adverse effects on the aquatic habitats in larger reservoirs, with increased sedimentation and some contaminant concentrations, such as mercury (Whiles and Garvey, 2004). The majority of the managed ponds are not affected by these same threats due to their smaller watersheds and contiguous Forest ownership and management. The protection of soil and water quality in watersheds of the larger reservoirs and amounts and types of aquatic-resource management are issues for these cultural communities and their respective species.

f. Cultural Communities

Cultural communities are floristic assemblages resulting from some form of human disturbance. They include abandoned pastures and agricultural croplands, tree plantations, wildlife openings and oldfields, roadsides and old home-sites. Plants occurring in these communities are a mixture of native, introduced and disturbance-adapted species. About 24 percent of the Forest is comprised of cultural communities, which occur in all of the ecological subsections of the Forest. Non-native pine-plantations are the largest of the cultural communities currently on the Forest. The degree and type of openland management allowed on the Forest is a major factor affecting these communities and their dependent species. Maintenance of grassland and oldfield habitats on the Forest is very important to maintaining species of early-successional habitats that depend on grasslands and shrublands, and to meeting our population-viability requirements for all native species.

Table 3-15. Effects in acres on communities and/or habitats for plants and animals on the Forest.

Ecological communities and habitats/Alternatives	Existing Condition	Alt. 1 20 years	Alt 1 100 years	Alt. 2 20 years	Alt. 2 100 years	Alt. 3 20 years	Alt. 3 100 years	Alt. 4 20 years	Alt. 4 100 years
Floodplain forest community/ mesic and wet-mesic floodplain forest/oak-hickory–dominated bottomland hardwood forests	6,300	6,300	8,300	6,300	8,300	6,300	8,300	6,300	8,300
Upland forest and woodland communities/ xeric, dry and dry-mesic forest/oak-hickory-dominated upland and bottomland forests	192,800	191,600	182,900	196,200	197,300	198,700	139,700	194,300	199,200
Upland forest community/ mesic forest/beech-maple-dominated forests	4,600	12,300	78,000	9,800	67,000	10,500	123,700	9,800	63,100
Floodplain forest community/ Riparian forests	9,100	9,100	9,100	Same as Alt. 1	Same as Alt. 1	Same as Alt. 1	Same as Alt. 1	Same as Alt. 1	Same as Alt. 1
Upland forest community/ dry-mesic and mesic forest/mixed-hardwood forests—not oak-dominated	24,900	24,900	12,500	25,100	11,100	25,100	15,400	25,100	11,200
Barrens community/ eastern-red cedar–dominated fields, glades and barrens	2,700	2,700	2,700	Same as Alt. 1	Same as Alt. 1	Same as Alt. 1	Same as Alt. 1	Same as Alt. 1	Same as Alt. 1
Cultural community/ grasslands	11,500	11,500	11,500	3,000	3,000	0	0	Same as Alt. 2	Same as Alt. 2
Cultural community/oldfields	9,500	9,500	9,500	3,700	3,700	0	0	Same as Alt. 2	Same as Alt. 2
Cultural community/wildlife openings	2,500	2,500	2,500	700	700	0	0	Same as Alt. 1	Same as Alt. 1
Cultural community/ pine plantations	44,800	44,600	0	44,400	0	44,400	0	44,400	0
Wetland community/swamps	1,000	1,000	1,300	1,000	1,300	1,000	1,300	1,000	1,300
Mature (over 50 yrs.) deciduous hardwood forest	191,900	200,200	234,700	201,000	187,600	200,600	261,100	200,900	182,800
Mature (over 50 yrs.) oak-dominated deciduous hardwood forest	177,800	169,600	155,400	172,300	120,600	171,400	134,000	172,200	119,600
Mature (over 50 yrs.) riparian, deciduous hardwood forest	7,100	7,100	7,100	Same as Alt. 1	Same as Alt. 1	Same as Alt. 1	Same as Alt. 1	Same as Alt. 1	Same as Alt. 1
Old-growth, deciduous hardwood forest	0	0	188,500	0	130, 100	0	223,900	0	128,700
Old-growth, oak-hickory forest	0	0	118,600	0	72,400	0	106,600	0	74,800

Ecological communities and habitats/Alternatives	Existing Condition	Alt. 1 20 years	Alt 1 100 years	Alt. 2 20 years	Alt. 2 100 years	Alt. 3 20 years	Alt. 3 100 years	Alt. 4 20 years	Alt. 4 100 years
Floodplain forest community/ mesic and wet-mesic floodplain forest/oak-hickory–dominated bottomland hardwood forests	6,300	6,300	8,300	6,300	8,300	6,300	8,300	6,300	8,300
70-acre or larger native or non-native grasslands (inc Dixon Springs Ag Center)	7,700	7,700	7,700	7,700	7,700	3,900	3,900	Same as Alt. 1	Same as Alt. 1
Caves and mines with known bat populations	Same as Alt. 1	All	All	Same as Alt. 1	Same as Alt. 1	Same as Alt. 1	Same as Alt. 1	Same as Alt. 1	Same as Alt. 1
Open oak woodlands (prescribed-burn acreage; natural areas only in Alt 3)	15,000	15,000	15,500	76,200	76,200	10,000	10,000	74,900	74,900
Swamps-in natural area or riparian filter strip (1,100-2,000 acres)	Same as Alt. 1	All	All	Same as Alt. 1	Same as Alt. 1	Same as Alt. 1	Same as Alt. 1	Same as Alt. 1	Same as Alt. 1
Perennial rivers and streams	150 miles	150 miles	150 miles	Same as Alt. 1	Same as Alt. 1	Same as Alt. 1	Same as Alt. 1	Same as Alt. 1	Same as Alt. 1
Managed springs, seeps (includes 16 large springs)	Same as Alt. 1	All	All	Same as Alt. 1	Same as Alt. 1	Same as Alt. 1	Same as Alt. 1	Same as Alt. 1	Same as Alt. 1
Rock outcrops (all acres in natural areas)	Same as Alt. 1	All	All	Same as Alt. 1	Same as Alt. 1	Same as Alt. 1	Same as Alt. 1	Same as Alt. 1	Same as Alt. 1
Early-successional (0-20 yrs old) hardwood forests	17,200	16,400	6,300	18,200	13,500	21,600	5,700	16,400	14,500

DIRECT AND INDIRECT EFFECTS ON ECOLOGICAL COMMUNITIES AND HABITAT-TYPES

Management under all alternatives would maintain the habitats and communities in their current conditions during the first twenty years of Plan implementation. However, in the long term (100 years), some major differences would result from implementation of the alternatives. In general, Alternatives 2 and 4 would provide for the greatest degree of biological diversity. See Table 3-15 for a summary of the effects in acres on communities and habitats.

Of most interest are changes in mature and old-growth forest, barrens, early-successional forest and openland communities. These are discussed here in detail. Alternatives 2 and 4 would maintain the greatest amount of the oak-hickory forest-type and the species dependent upon it. They would maintain the communities, vegetation-types and successional stages important to all native species on the Forest, including many at-risk species. Alternatives 2 and 4 would maintain almost 100 percent of the existing oak-hickory forest habitat and community in the long term (100 years), while Alternatives 1 and 3 would maintain less—5 percent and 28 percent less—respectively.

Alternative 1—with less proposed forest management and prescribed fire than under Alternative 2—would maintain 95 percent of the oak-hickory forest-type in 100 years following implementation and 87 percent in 150 years. Alternative 3 would maintain the oak-hickory forest on only 10,000 acres of natural areas and dry sites due to natural, wind events, or about 70 percent of the oak-hickory forest in 100 years following implementation and 60 percent in 150 years. Existing biodiversity would decline to some extent under all alternatives, considering the general decline of the oak-hickory and early-successional forest communities and habitats, with the least decline expected under Alternatives 2 and 4, and the most under Alternative 3.

Activities that could affect communities and habitats are restrictive management, especially as it affects old-growth and mature forests; timber harvest, as it affects old-growth, mature and early-successional forests; vegetation treatments, as they affect oak-hickory species and barrens-community diversity; fire management, as it affects oak-hickory forest and barrens diversity; openings and openlands management, as it affects cultural communities and associated species diversity and abundance; aquatic resource management, as it affects the diversity and abundance of wetland communities; and land-ownership adjustment. All other management and use activities under all alternatives are expected to have relatively no effect or no measurable effect on the coarse biodiversity elements and measures at the community/broad-habitat scale. Considered in light of implementation of Forest-wide standards and guidelines, they would not affect any communities or habitats to the extent necessary for a net measurable change in overall species abundance and distribution on the Forest.

1. Restrictive Management

Restrictive management under all alternatives would provide for mature and old-growth hardwood forest habitats, with the most provided under Alternative 3— in 100 years, about 223,900 acres, or 79 percent of the Forest. However, this mature and old-growth forest would be dominated by sugar maple and beech species rather than oak and hickory species. Restrictive management would also continue to maintain and improve community and habitat diversity in cliff, cave, wetland and aquatic communities through implementation of management for the protection of these communities from soil-disturbing activities and unregulated, dispersed recreation.

2. Timber-Harvest

Timber-harvest methods under any of the alternatives would have no direct or indirect effects on cliff, cave, wetland or aquatic communities, as none would occur in these communities. Any indirect effects from timber harvest in adjacent areas would be mitigated by the implementation of Forest-wide standards and guidelines. Timber harvest would have the indirect, beneficial effect of maintaining early-successional and oak-hickory-dominated forests for species dependent upon these habitats.

a. Alternative 1

Alternative 1 would maintain 6 percent of the Forest in early-successional forest conditions in the short term, due primarily from the ecological restoration of pine plantations. In the long term, this alternative would maintain only 2 percent of the Forest in early-successional habitat and 60 percent in oak-hickory forest.

b. Alternatives 2 and 4

Alternatives 2 and 4 would maintain the most habitat and habitat diversity for species associated with early-successional forests, including northern bobwhite and yellow-breasted chat. About 5 percent of the Forest would be maintained in early-successional habitat in any ten-year period. These alternatives would also maintain the most oak-hickory–dominated forests (70 percent of the Forest) in the long term for the species dependent upon this habitat.

c. Alternative 3

Alternative 3 would maintain about 8 percent of the Forest in early-successional forest habitats in the short term (20 years), due to the succession of openings and openlands resulting from inaction in these habitats. In the long term, Alternative 3 would maintain only 2 percent of the Forest in early-successional forest conditions. Of all the alternatives, this one would maintain the least amount of oak-hickory–dominated forest (50 percent of the Forest) in the long term.

3. Vegetation Treatment

Under all alternatives, vegetation treatment would have no direct or indirect effects on cliff, cave, wetland, or aquatic communities, as none would occur in these communities. Any indirect effects from vegetation treatment in adjacent areas would be mitigated by the implementation of Forest-wide standards and guidelines.

The direct and indirect effects of vegetation-management activities would be the augmentation of timber harvest; the maintenance of oak-hickory community and habitat dominance in the even-aged hardwood and mature-forest management areas, natural areas and the Oakwood Bottoms Greentree Reservoir; and maintenance of the diversity of barrens and glades in natural areas. Alternative 3 would include vegetation-treatment activities in the Oakwood Bottoms Greentree Reservoir and natural areas to a lesser degree than the other alternatives. Alternatives 1, 2 and 4, with their planned vegetation-management activities, would contribute more than Alternative 3 to maintaining biodiversity, especially the diversity represented by oak-hickory forest communities and habitats.

4. Fire Management

Under all alternatives, fire management would have no direct or indirect effects on cliff, cave, wetland or aquatic communities, as none would occur in these communities. Any indirect effects from fire management in adjacent areas would be mitigated by the implementation of Forest-wide standards and guidelines.

Under all alternatives, the direct and indirect effects of fire management would be the maintenance of upland and bottomland oak-hickory forest communities and habitats, a variety of barrens communities, openlands and grasslands, and the plants and animals dependent upon them. Alternatives 2 and 4 would allow the most prescribed fire—about 30 percent of the Forest—and, so, support the biodiversity associated with fire-dependent communities, including oak-hickory forest and woodlands, barrens and grasslands.

Compared to Alternatives 2 and 4, Alternative 1 would allow a lesser degree of prescribed fire and Alternative 3 the least, allowing fire only in natural areas and affecting only four percent of the Forest. These alternatives would offer the least support to the maintenance of fire-dependent and/or -adapted communities.

5. Openings and Openlands Management

Under all alternatives, openings and openlands management would have no direct or indirect effects on cliff, cave, wetland or aquatic communities, as none would occur in these communities. Any indirect effects from openings and openlands management in adjacent areas would be mitigated by the implementation of Forest-wide standards and guidelines.

The direct and indirect effects of openings and openlands management activities under Alternatives 1 and 4 would be the provision of the most acreage and diversity for species dependent upon large-grassland and oldfield habitats. Alternative 3 would provide the least. Alternative 2 would maintain 13 to 15 of the largest and most diverse grasslands and oldfields across the Forest. Alternative 3 would maintain the least—only the existing habitats for the Henslow’s sparrow and the loggerhead shrike, approximately 1,000 acres. Alternatives 1, 2 and 4 would allow for the expansion and/or long-term maintenance of populations of species dependent upon large openlands, including the Henslow’s sparrow, loggerhead shrike, northern bobwhite and yellow-breasted chat.

6. Aquatic Resources Management

Under all alternatives, aquatic resources management is proposed for streams, lakes, ponds and waterholes, reservoirs, wetlands and the Oakwood Bottoms Greentree Reservoir. Management to maintain and/or improve these habitats would contribute greatly to maintaining the abundance and distribution of aquatic plants and animals on the Forest.

Swamp-wetlands are extremely rare communities and habitats in Illinois and on the Forest (Whiles and Garvey, 2004). Management of perennial and ephemeral wetlands in the Middle Mississippi and Ohio Rivers floodplains, including both restoration and maintenance actions, also contributes substantially to overall wetland biodiversity. Management of the Oakwood Bottoms Greentree Reservoir maintains ephemeral, forested wetlands and bottomland forest communities and the relatively large number of rare plants and animals dependent upon them.

All alternatives would maintain similar wetland diversity by maintaining and improving aquatic resources similarly. Notable improvements in aquatic-resource management would be made under all alternatives in the Mississippi River Alluvial Plain ecological subsection.

The indirect effects of the management activities proposed under all alternatives would be the improvement and maintenance of affected aquatic habitats and communities, with similar, beneficial effects on maintaining the biodiversity of aquatic species.

7. Land-Ownership Adjustment

Under all alternatives, land-ownership adjustment activities could benefit biodiversity in all communities under all alternatives as additional communities and habitats are acquired and opportunities for beneficial management are increased. Effects would be similar since land-acquisition guidelines do not vary by alternative.

CUMULATIVE EFFECTS ON COMMUNITIES AND HABITATS

This discussion of cumulative effects takes into consideration the past, present and reasonably foreseeable future actions specified at the beginning of Chapter 3.

1. Barrens

Barrens are among the rarest natural communities today within the Forest and its vicinity. Historically, they were more widespread and diverse in all the ecological subsections of the Forest (Hutchinson *et al.*, 1986 and Parker and Ruffner, 2004). Without the disturbance of fire, barrens communities in southern Illinois have disappeared and/or become less diverse (Anderson *et al.*, 2000). Approximately 28 of the most diverse barrens remaining on the Forest were managed in the late 1980’s and 1990’s with fire and some tree and shrub removal. However, these management activities have stalled to date pending completion of additional environmental planning. State heritage biologists have managed the most diverse barrens remaining on state and private areas near the Forest with fire and some tree and shrub removal.

Any alternative would continue and promote the management of the most diverse barrens habitats and communities on the Forest. However, even with management, these communities would remain rare on the Forest. Implementation of Alternative 1, 2 or 4, which allow landscape-scale burning combined with continued barrens management on nearby state and private lands, would maintain a greater degree of biodiversity both within and among barrens communities than Alternative 3. Under Alternatives 1, 2 and 4, isolated barrens remnants in some areas of the Forest would be connected to woodland communities, allowing in the short and long terms for the movement of plant and animal species among individual and formerly isolated barrens. This is not expected to occur under Alternative 3, since landscape-scale burning near barrens communities would not be allowed.

Considering past, present and reasonably foreseeable future actions and effects on these communities, mainly related to inaction, wildfire and prescribed fire, timber harvest, agricultural activities—disking, plowing, seeding, planting, mowing—and residential development, both on and near the Forest, the actions proposed under Alternative 1, 2 or 4 are expected to result in greater beneficial, cumulative effects than under Alternative 3 on these communities and habitats and the rare plant and animal species dependent on them and on the biodiversity of the Forest.

2. Forests

Ponder (*Assessment*, 2004) and Parker and Ruffner (2004) describe the historical land uses and changes that have occurred in the various ecological subsections on the Forest and in the vicinity of the Forest. Fire, including burning by Native Americans and later European settlers, grazing, agricultural clearing, intensive logging and land-drainage were common. Wind and ice storms were the historical natural disturbances (Parker and Ruffner, 2004). In presettlement times, forests were dominated by oak-hickory species, with increased numbers of American beech, sugar maple and yellow poplar across the more mesic sites (McArdle, 1991; Fralish *et al.*, 2002). Mesophytic species such as American beech and sugar maple were restricted to the low and alluvial sites predominantly in the Illinois Ozark Hills and, to a lesser extent, in the Lesser and Greater Shawnee Hills (Fralish *et al.*, 2002). Beech and maple are expected to continue to dominate these historical sites in the future.

Deciduous forests dominated by oaks and hickories produce hard seeds, called nuts and hard mast. These hard-mast food-sources in oak-dominated forest communities are available to many native wildlife species as high-energy foods during dormant seasons when green growth is absent (Healy and McShea, 2002).

Today, with the lack of disturbance, maple and beech dominate the understories of most of the deciduous forest, except for the driest sites. Oak-hickory species that now dominate the overstory of the forest communities are overmature and slowly dying out, being replaced by maple and beech in all the ecological subsections (Parker and Ruffner, 2004). This results in much less diversity in the forest communities, as well as much fewer hard-mast food-sources for native wildlife. Declines in herbaceous, understory plants and plant diversity (Fralish, 1997), insect abundance and diversity (Fralish, 1997) and avian and mammalian species diversity (Rodenwald, 2003; Rodenwald and Abrams, 2002; Healy and McShea, 2002) are predicted for the future when maple assumes overstory dominance in these forests. These changes are also happening near the Forest, for the most part on privately owned, unmanaged, forest lands; but also, to some degree, on managed, privately owned forest lands (Schmidt *et al*., 2000).

a. Alternative 1

Considering past, present and reasonably foreseeable future actions and effects on these communities, mainly related to inaction, wildfire and prescribed fire, grazing, timber harvest, agricultural activities—disking, plowing, seeding, planting, mowing—and residential development, both on and near the Forest, the actions proposed under Alternative 1 are expected to result in less beneficial, cumulative effects than under Alternatives 2 and 4, as it would allow less management of oak-hickory forests. Implementation of this alternative would result in the greatest amount of old-growth, oak-hickory forest, with about 80 percent of all forest communities over 120 years of age in 100 years (Table 3-15). It would also provide the most mast-producing forests in 150 years (oak-hickory forest over 50 years old) (Table 3-16). On the other hand, it would be lacking in early-successional forest-habitat conditions and would result in less overall oak-hickory forest in the long term, compared to Alternatives 2 and 4. Implementation would contribute cumulatively to the overall and continued decline of these communities and habitats and of the biodiversity of the Forest.

Table 3-16. Acreage of mast-producing forests in short term and long term, as calculated by the Spectrum model.

	Alt. 1	Alt. 2	Alt. 3	Alt. 4
Existing condition: oak-hickory forests	192,800	192,800	192,800	192,800
Existing condition: mature (over 50 years) oak-hickory forests	177,800	177,800	177,800	177,800
Oak-hickory forests in short term (20 years)	191,600	196,200	198,700	194,300
Mature (over 50 years old), mast-producing, oak-hickory forests in short term (20 years)	169,600	172,300	171,400	172,200
Oak-hickory forests in long term (150 years)	166,772	192,776	115,808	195,045
Mature (over 50 years old), mast-producing, oak-hickory forests in long term (150 years)	147,950	123,971	110,310	126,849

b. Alternatives 2 and 4

Considering past, present and reasonably foreseeable future actions and effects on these communities, mainly related to inaction, wildfire and prescribed fire, grazing, timber harvest and agricultural activities—disking, plowing, seeding, planting, mowing—both on and near the Forest, the actions proposed under Alternatives 2 and 4, which allow more intensive timber and fire management, are expected to have more beneficial, cumulative effects on the biodiversity of forest communities (both understories and overstories) on the Forest and in southern Illinois.

Implementation of either alternative would result in a lesser amount of old-growth forests than under Alternatives 1 and 3, a lesser amount of mast-producing trees in the long term than under Alternative 1 (Table 3-16), but a greater degree of diversity of forest successional-stages, providing the most interconnected, overall, plant and animal diversity. Implementation of either of these alternatives would result in beneficial, cumulative effects on these communities and habitats and on the biodiversity of the Forest, since they result in the most oak-hickory-dominated forests and the most age-class diversity of forests in the long term (Table 3-15).

c. Alternative 3

Even though implementation of Alternative 3 would result in the greatest amount of old-growth forest, it would also result in some degree of loss of forest-community biodiversity, as oak-hickory forest communities decline and are replaced with maple-beech forests in the long term. It would also result in fewer mast-producing trees in the long term (Table 3-16). Considering past, present and reasonably foreseeable future actions and effects on these communities, mainly related to inaction, wildfire and prescribed fire, grazing, timber harvest and agricultural activities—disking, plowing, seeding, planting, mowing—both on and near the Forest, the actions proposed under Alternative 3 are expected to result cumulatively in a relatively large, overall and continued decline in the biodiversity of southern Illinois forests, especially of oak-hickory forests (Table 3-15).

3. Woodlands

Woodland communities are extremely rare anywhere in Illinois due to the lack of fire on both private and public lands in dry forests and adjacent barrens. They occur as fragments in all ecological subsections on the Forest. Presettlement woodland community and habitat conditions in southern Illinois were described as isolated fragments within a forested landscape (Anderson and Anderson, 1975; Evers, 1955; Fralish *et al.*, 1999). They were and still are dependent upon fire-disturbance to maintain their open character and diversity. Lack of fire in the 20th century due to fire suppression has resulted in a severe reduction in the diversity of woodland communities, with most succeeding to forest. With the active management of natural areas on the Forest, and by the state on adjacent state and private lands in the late 1980's, some small amount of woodland habitat diversity was improved and increased. Fire management in natural areas with woodlands on both private and state lands, together with approximately 10,000 acres on the Forest, is expected to continue in the future.

All alternatives would allow prescribed fire on 10,000 acres of natural areas and, so, benefit woodland communities and habitats. Alternatives 1, 2 and 4 would also allow burning in surrounding hardwood forests, further benefiting woodland communities and their biodiversity. Considering past, present and reasonably foreseeable future actions and effects on these communities, both on and near the Forest, the actions proposed under any of the alternatives are expected to result in beneficial, cumulative effects on these communities and habitats, and on the biodiversity of the Forest. Because Alternatives 2 and 4 allow the greatest degree of prescribed fire, they would result in more beneficial, cumulative effects than Alternatives 1 and 3.

4. Cliffs, Rock Outcrops, Caves

Historically, most cliffs, rock outcrops and caves on the Forest were not altered ecologically, even though humans used most for recreation and shelter. A few of the limestone cliffs were quarried. Presently, most include intact complements of flora and fauna. The majority of the most-diverse cliff and rock-outcrop communities in southern Illinois, as well as some of the most diverse caves, are on either state or federal lands. These communities on or controlled by public agencies are managed to maintain the diversity of their resources into the future.

Considering past, present and reasonably foreseeable future actions and effects on these communities, both on and near the Forest, the actions proposed under any of the alternatives are expected to result in beneficial, cumulative effects on these communities and habitats, and on the biodiversity of the Forest.

5. Wetlands

Historically, wetland communities such as swamps were common throughout floodplains of the major rivers and streams in southern Illinois (Whiles and Garvey, 2004). Streams, springs and seeps were important historically to humans, providing for their water and, in some cases, transportation. Following European settlement, they were severely affected, reduced to isolated fragments primarily by agriculture and associated drainage and forest-clearing in the major watersheds and floodplains on or near the Forest (Whiles and Garvey, 2004).

Since the 1960's, streams and wetlands have been protected from soil-disturbing activities and adverse effects on water quality. Since the mid-1990's, wetland communities have been, and should continue to be, maintained and improved both on and off the Forest. This would be accomplished on the SNF through implementation of Forest-wide standards and guidelines and compliance with the Clean Water Act, and off the Forest through compliance with the Clean Water Act, implementation of the Conservation and Wetland Reserve Programs (CRP and WRP) and other watershed and wetland management programs on private, state and federal lands. Wetland management, including restoration and protection on both private and public lands, is expected to continue and increase, especially in the Mississippi River Alluvial Plain and the Illinois Ozark ecological subsections.

Considering past, present and reasonably foreseeable future actions and effects on these communities, notably the Forest's present and future coordination of efforts with the IDNR, the NRCS and the Middle Mississippi River Partnership—which focuses on management of both private and public lands in this major river system and floodplain—both on and near the Forest, the actions proposed under any of the alternatives are expected to result in beneficial, cumulative effects on wetland communities and habitats on and near the Forest, and on the biodiversity of the Forest.

6. Cultural Communities

Cultural communities, such as pastures, agricultural fields, oldfields, roadsides, wildlife openings and old home-sites proliferated following European settlement. Some of these communities existed to some extent in presettlement times, associated with Native American habitation and agriculture. Tree plantations, primarily of pine, began in the late 1930's following establishment of the SNF. All persist today. Small amounts of these communities—mainly oldfields, old home-sites, wildlife openings and roadsides occur on the Forest, while surrounding private lands are dominated by these communities in most of the ecological subsections. Of all these cultural communities, oldfields harbor the most biological diversity of native plants and animals, providing quality habitats for species dependent upon early-successional forest habitats and native grasslands. The other cultural communities are much less diverse than most natural communities near the Forest.

Cultural communities on private lands in southern Illinois are expected to remain a dominant feature of the southern Illinois landscape, including the Forest. Implementation of any of the alternatives would result on the Forest in the eventual, near-total reduction of non-native pine plantations, with Alternatives 1, 2 and 4 accomplishing this through active management much sooner than Alternative 3, which would require the natural decline and mortality of the pines. Existing pine plantations would be replaced by native hardwood-forest communities, with some isolated pine trees possibly persisting. This would benefit the overall biodiversity of the Forest and the region, as the reforested areas would again be habitat for many native species. At present, they have a much smaller complement of native species than native forest habitats.

a. Alternative 1

Implementation of Alternative 1 would maintain on the Forest the most acreage of cultural communities of all the alternatives, especially in oldfields, as all wildlife openings and oldfields would be maintained. Considering the past, present and reasonably foreseeable future actions and effects on these communities, both on and near the Forest, implementation of this alternative would result in beneficial, cumulative effects on these communities and habitats and on the biodiversity of the Forest.

b. Alternatives 2 and 4

Alternatives 2 and 4 would focus management on the maintenance of larger expanses of grasslands and oldfields to benefit declining and/or rare species, such as northern bobwhite and Henslow's sparrow. The locations of managed openlands under these alternatives is linked to those identified for grassland bird species by the Central Hardwood's Bird Conservation Joint Venture and, thus, is coordinated to provide the best overall habitat for grassland and oldfields species in this larger ecological region. These managed openlands would contribute regionally to maintaining and improving habitats and, subsequently, populations of openlands species at risk of serious decline. Considering these actions, as well as the past, present and reasonably foreseeable future actions and effects on these communities, both on and near the Forest, implementation of either of these alternatives would result in beneficial, cumulative effects on these communities and habitats and on the biodiversity of the Forest.

c. Alternative 3

Alternative 3 would maintain a minimal amount, if any, of these cultural communities and, thus, would have no beneficial effect on edge, early-successional forest and grassland species. Regional populations of some rare or declining species in southern Illinois, such as the Henslow's sparrow, would decline. Considering past, present and reasonably foreseeable future actions and effects on these communities, both on and near the Forest, the actions proposed under this alternative are expected to result cumulatively in adverse effects on at-risk, openlands, wildlife species and their habitats and on the biodiversity of the Forest.

PART TWO: VIABILITY OF SPECIES

The discussion of biodiversity thus far has described the ecological communities and habitat that are important to maintaining the biodiversity and viability of the majority of the plant and animal species native to the Forest. Because it is impossible to ensure viability on a species-by-species basis, the conservation of habitats for species is central to providing for the viability of all species (TNC, 1982). Management of dynamic landscapes for the adequate representation of all ecological units is vital to conserving species diversity. The preceding analysis of the management of ecological communities was, then, a coarse-filter analysis of biodiversity.

This section, addressing the viability of species at risk, describes and analyzes effects on individual species of various ecological areas of the Forest, many of which have some degree of population-viability risk on the Forest. Conserving these species, along with all the ecological units that are part of the Forest landscape, would result in the maintenance and/or improvement of the biodiversity of the Forest. The analysis of effects on these at-risk species is, then, the fine-filter analysis of biodiversity.

At-risk species were identified in the aquatic and terrestrial animal and plant species sections of the Assessment (Olson *et al*., 2004; Burr *et al*., 2004; McCreedy *et al*., 2004). All at-risk species on the Forest have low populations throughout their range due to their rarity; the uniqueness of their habitats; and/or the decline of their habitats due to past human disturbances, continued habitat threats and/or the lack of ecological disturbances. A team of scientists from universities and state agencies of Illinois and Indiana reviewed the status of the species' viability in the Assessment area and assisted in evaluating the risks to maintenance of viable populations in the area. Appendix E includes a list of these species and the details of the species-evaluation process.

The at-risk species are discussed in four groupings: 1) management-indicator species, 2) species with viability risk, 3) species federally listed as threatened or endangered and 4) species listed as sensitive by the Regional Forester.

1. MANAGEMENT-INDICATOR SPECIES (MIS)

The wildlife of the Forest is demonstrably diverse, with approximately 500 vertebrate species: 51 mammals, 237 birds, 47 reptiles, 32 amphibians and 112 fish; and numerous insects and invertebrates, as well. They play a vital role in the Forest ecosystem. Management of the Forest is intended to protect the biodiversity and health of the ecosystem. This is accomplished through compliance with federal laws and agency regulations and by implementation of management standards and guidelines that support the biodiversity and health of the ecosystem.

Some of the wildlife species are designated MIS, or species that, with their habitats, can be monitored reasonably to determine effects of management and use. They play an important ecological role and are representative of changes in other species with similar habitat requirements. They generally are species whose habitat and population information is known: they have been monitored in the past and their population trends have been determined. There is usually a documented cause-and-effect relationship between Forest activities and changes on the Forest in MIS populations.

The 1992 Forest Plan lists 18 MIS, each intended to represent the inhabitants of one or another habitat on the Forest. Upon review of the MIS during revision of the Plan, it was determined by the interdisciplinary team that the current list does not provide adequate and appropriate information.[1] This led to examination of the criteria for MIS-selection and to the selection of species more finely focused to reveal the biodiversity goal of the proposed Forest Plan.

The interdisciplinary team designated five bird species as MIS that, among themselves, have provided over many years, and are expected to continue to provide, reliable data on the state of the early-successional forests, as well as the mature hardwood forests and openlands—key issues for the Forest. Mature hardwood forests are vitally important as habitat for forest-interior species and in determining the vigor of oak-hickory forests. Early-successional forests are essential to maintaining the vigor of oak-hickory forests and the early-successional wildlife species dependent upon them. The maintenance of grassland and oldfield habitats on the Forest is important to wildlife dependent on early-successional habitat. Maintenance or enhancement of these three habitat-types is critical to meeting the population-viability requirements of all native species. The MIS are the yellow-breasted chat and northern bobwhite of early-successional forest, grasslands and oldfields, and the scarlet tanager, wood thrush and worm-eating warbler of the mature-hardwood forest. More detailed information on each of the five MIS is included in Appendix E.

a. Habitat Suitability Index (HSI) Model

A model developed initially by the Missouri Department of Natural Resources and subsequently modified for the species of southern Illinois and the Forest was used to predict the effects of various management activities on MIS habitats and populations. The HSI model assigns scores to habitat variables that are preferred or avoided by MIS. High scores are given for preferred habitat conditions and lower scores for sub-optimal conditions. The model also assigns scores to the type, diversity and abundance of vegetation, distance to water, distance to agricultural land, amount of fragmentation in the area, and several other characteristics that may be important to the species. The model predicts the quality—the HSI—and quantity of habitat available to the MIS in a measure of habitat capability (HC): HC = HSI x acres. More information on the model is included in Appendix E.

Characterization of the current condition has been based on a stratified, random sample of 263 sites across the Forest. The entire forest was divided into small, unique stands based on the age and type of habitat. Each stand was assigned a chronological number and a random-number generator was used to select sample-sites. Habitats were divided into four types: bottomland forest, upland forest, oldfield and grassland. A 95-percent confidence-interval was used to choose the number of sample-sites for each habitat. The sampling was conducted in the fall of 2003.

[1] This in terms of the availability and quality of monitoring data and the capability of the data to convey useful information regarding the effect of management on the general health of the Forest ecosystem.

b. MIS Population and Nesting-Success (for Some Species) Trends

Population trends for the five-year period 1999 to 2003, calculated from specific monitoring on the Forest and for the eight-year period 1993 to 2001 (since approval of the 1992 Plan), from six breeding-bird survey routes administered by the US Fish and Wildlife Service within or adjacent to the Forest (see planning record) indicate the following for MIS populations within the Forest boundary:

- Northern bobwhite populations are stable to slightly declining (1993-2001).
- Yellow-breasted chat populations are declining slightly (1993-2003).
- Worm-eating warbler populations are increasing, but these trends are based upon only a few samples (1993-2003).
- Scarlet tanager populations are increasing (1999-2003 and 1993-2003).
- Wood thrush populations are stable to slightly increasing (1999-2003 and 1993-2003).

The local population trends of MIS generally follow changes in the quantity and quality of their habitats on the Forest. However, some of these local trends are different than statewide or regional trends for the same species.

- Northern bobwhite populations have declined slightly in Illinois over the last 22- and 34-year periods (USFWS, Breeding-Bird Survey; Kleen *et al*., 2004), down 1.5 percent per year and 1.9 percent per year, respectively; and throughout the Hoosier-Shawnee ecological area (down 3.1 percent per year for the Highland Rim) during the last 34 years (McCreedy *et al*., 2004).

- Yellow-breasted chat populations have declined slightly in Illinois over the last 22- and 34-year periods (USFWS, Breeding Bird Survey; Kleen *et al*., 2004), down 2.9 percent per year and 3.4 percent per year, respectively; and throughout the Hoosier-Shawnee ecological area (down 2.5 percent per year for the Highland Rim) during the last 34 years (McCreedy *et al*., 2004).

- Worm-eating warbler populations have declined slightly (down 0.6 percent per year) in Illinois over the last 22 years (USFWS, Breeding Bird Survey) and increased over the last 34 years (up 4.6 percent) (Kleen *et al*., 2004). Local trends (1999 to 2003) indicate that populations are increasing (planning record). Overall nesting success for this species does not appear to be heavily affected by cowbird parasitism or predation, as the species is considered abundant on the Forest (Robinson and Cottam 2004). In the larger Hoosier-Shawnee ecological area (Highland Rim), worm-eating warbler populations have declined slightly (down 1.6 percent per year) during the last 34 years (USFWS, Breeding Bird Survey). This latter trend may be more reliable as a population-trend indicator for the species since it is based on more samples.

- Scarlet tanager populations have declined slightly in Illinois over the last 22- and 34-year periods (USFWS, Breeding Bird Survey; Kleen *et al*., 2004), down 1.1 percent per year and 2.5 percent, respectively. However, the species has increased slightly on the Forest (planning record) and throughout the Hoosier-Shawnee ecological area (up 2.9 percent year for the Highland Rim) during the last 34 years

(McCreedy *et al.*, 2004). While local evidence of the nesting success of this species is not abundant, Robinson and Cottam (2004) consider the species to be holding its own or increasing on the Forest. This is a likely indicator that the species is not having nesting-success problems on the Forest.

- Wood thrush populations have decreased slightly in Illinois over the last 22 years and 34 years (USFWS, Breeding Bird Survey; Kleen *et al.*, 2004), down 2.3 percent year and 1.3 percent per year, respectively. The species appears to be stable on the Forest (planning record) but has decreased slightly throughout the Hoosier-Shawnee ecological area (down 0.7 percent per year for the Highland Rim) during the last 34 years (USFWS, Breeding Bird Survey). However, the species is documented as having nesting-success problems on the Forest (Trine 1998).

The statewide and regional population trends for the early-successional and openlands-dependent species appear to match local trends in populations and the quality and quantity of these habitats in southern Illinois. The statewide and regional population trends for the mature-hardwood forest species do not appear to consistently match local population trends, or the increasing quantity of mature hardwood forests in southern Illinois. Mature-hardwood forest has increased in southern Illinois and on the SNF since 1992 (Schmidt *et al.*, 1998).

Fragmentation and edge effects from wildlife openings on the Forest have also declined since 1992, due to the general reduction in wildlife-opening management across the Forest. There also have been small amounts of reduction in edges, especially agricultural edges on private lands within the Forest boundary, linked to the Forest's acquisition and land-consolidation programs and to Conservation Reserve Programs administered by the NRCS on private lands. All these factors have resulted in improved habitat quantity and quality for species associated with mature hardwood forests. These habitat improvements appear to have had some beneficial effects locally on species such as the wood thrush, but do not appear to have yet had a similar and associated effect on populations of these species at state and regional levels.

Continued declines in habitat quality associated with fragmentation, especially from agriculture, and increased brood-parasitism and predation-levels associated with landscape-scale fragmentation—both identified as threats to the viability of these species—still appear to be adversely affecting populations of some of the MIS, especially at state and regional levels. Effects on the species and their winter habitats could also be having a strong effect on the population trends of these Neotropical migrants. Also, some of these mature forest species may require some interspersed early- and mid-successional hardwood forest habitats to complement their life-history needs (Thompson *et al.*, 1992). Continued declines in oak-hickory forest diversity may also have some additional adverse effects in the future for some MIS that are more dependent upon this forest community, such as the scarlet tanager. Finally, it may take more years before improvements in habitat quantity and quality on the breeding-grounds for mature hardwood forest-species are reflected in increased populations of individual MIS, especially at the state and regional levels.

Based upon their declining, regional-population trends, the northern bobwhite, yellow-breasted chat, wood thrush and worm-eating warbler are all listed as species of concern in the Central Hardwoods Bird Conservation Region that includes the Hoosier and Shawnee National Forests.

DIRECT AND INDIRECT EFFECTS ON MIS

The anticipated effects of implementing the four alternatives are based on the typical response of the modeled habitats to each of the management or use activities. The effects were determined by a team of wildlife biologists with more than 20 years' professional experience on the Forest. Direct, indirect and cumulative effects are addressed. The FEIS addresses 13 management and use activities. Of these 13, seven were "built into" the HSI model: restrictive management, roads and trails management, timber-harvest methods, vegetation treatments, fire management, integrated pest management and openings and openlands management. Their effects are reflected in the HSI and HC values. The effects of the remaining six activities—recreational use of trails and roads, dispersed recreation, developed recreational site use, aquatic resource management, minerals management and land-ownership adjustment—are discussed for each alternative. See Table 3-17 for a summary of effects in acres on MIS habitats. The discussion of effects focuses on the second and tenth decades of implementation of the proposed Plan, the former timeframe reflecting the end of the life of the Plan and the latter timeframe reflecting the anticipated effects of proposed Plan management into the next century.

Table 3-17. Summary of effects on MIS habitats (in acres).

MIS	Habitat Indicators from Table 3.37 above	Alt. 1	Alt. 2	Alt. 3	Alt. 4
Northern bobwhite and yellow-breasted chat	Grasslands, oldfields and wildlife openings in decades 2 and 10	23,500 23,500	7,400 7,400	0 0	23,500 23,500
Northern bobwhite and yellow-breasted chat	Early-successional hardwood forest in decades 2 and 10	16,400 7,000	18,200 13,800	21,600 5,700	16,400 14,900
Wood thrush, worm-eating warbler, scarlet tanager	Mature (saw-timber and old-growth) hardwood forest in decades 2 and 10	200,900 181,300	200,900 186,300	200,600 261,100	200,900 181,300

1. HSI-Modeled Management and Use Activities

The direct, indirect and cumulative effects of these management and use activities are reflected in HSI and HC scores.

a. Alternative 1

i. Early-Successional MIS

(yellow-breasted chat, northern bobwhite)

Implementation of Alternative 1 and the HSI-modeled activities would result in beneficial, indirect effects through the second and tenth decades. This alternative would provide 23,500 acres of managed openland habitat for both early-successional MIS and 16,400 acres and 7,000 acres of early-successional hardwood habitat in the second and tenth decades, respectively. These habitats provide the optimum benefits for both species. The HC would increase 7 percent for northern bobwhite and 22 percent for yellow-breasted chat, due to the management of grasslands, oldfields and wildlife openings that would provide an increase in both the quantity and quality of available habitat. Prescribed fire would be used to stimulate herbaceous groundcover, increase plant diversity and promote oak-hickory regeneration. The conversion of pine stands to oak-hickory and timber harvest by group selection also would provide more early-successional habitat for both quail and chats.

Implementation of this alternative would result in mixed, indirect effects on MIS by the tenth decade. Northern bobwhite would experience a small decrease in HC—almost two percent—while the yellow-breasted chat would show improvement over current conditions—a gain of almost 12 percent. This shift in HC is the result of the relatively small scale at which management practices of Alternative 1 would be implemented. Once existing pine-stands have been converted to hardwoods that have matured beyond the early-successional stages, the habitat would become less suitable for these MIS. The continued management of oldfields and grasslands would benefit early-successional species; but the small openings developed by group-selection timber harvest and the limited scale of harvest in bottomlands and uplands, offset the gains made in other habitats.

ii. Mature-Forest MIS

(scarlet tanager, wood thrush, worm-eating warbler)

Implementation of Alternative 1 could result in some direct effects on the mature-forest MIS. When mature trees are harvested by group selection, it is possible for some individuals and/or nests to be lost in the process. Timber harvest could take place throughout the year at scattered locations across the forest, enabling harvest to occur outside MIS nesting-seasons, when they are the most vulnerable. The scarlet tanager would most likely be directly affected by timber harvest, since it nests in the canopies of mature trees. Wood thrushes and worm-eating warblers nest in shrub-cover or understory trees and on the ground, respectively, and so are less likely to be affected.

Implementation of this alternative would provide 200,900 acres and 181,300 acres of mature hardwood habitat in the second and tenth decades, respectively. These habitats in unfragmented areas provide the most benefit for the three MIS. Not all of this acreage is in unfragmented areas. Only 9,300 acres outside of wilderness areas, areas recommended for wilderness study, Camp Hutchins and candidate wild and scenic rivers are managed to reduce fragmentation. The annual acreage proposed for group-selection timber harvest in mature hardwoods in the first 20 years (short term) is about 670 of the 174,300 acres managed as uneven-aged and mature hardwood forest (0.4 percent) (Spectrum Model runs, planning record). This hardwood harvest in the first 20 years would affect only seven percent of the hardwood forest areas available for harvest and only five percent of the entire Forest. The Spectrum model indicates that, in the long term (100 years), approximately 117, 500 acres of mature hardwoods could be affected by timber harvest—67 percent of the hardwood forest available for harvest and 41 percent of the entire Forest.

Prescribed burns would generally not be done in mature forests during the breeding seasons of associated MIS, so there should be no direct effects on them from this activity. Indirect effects of prescribed fire in fall, winter and spring could be reductions in residual nesting-cover at ground level the following summer nesting-season and, thus, a possible loss of worm-eating warbler reproduction. The wood thrush likewise could be indirectly affected by burning and any associated reduction in shrub and small-tree cover the following nesting-season. The scarlet tanager, a canopy-nester, would not be indirectly affected. Because the burn areas would be rotated to provide residual cover, and the burns would be scheduled before spring migration or after the nesting/fledgling season in the fall, any adverse indirect effects on the warbler or thrush would be minimized.

Implementation of Alternative 1 would result in minimal direct effects on any of the mature-forest MIS, so no change in current population trends is anticipated. Indirect effects would result in more and higher-quality habitat and a higher HC for each species in the short term. Scarlet tanager HC would be elevated by almost six percent, wood thrush almost eight percent and worm-eating warbler less than one percent. Even though these species are considered mature-forest species and there would be some degree of group-selection timber harvest, the quality of the mature habitat would be improved with the management practices, offsetting the loss of mature trees. In addition, the quantity of preferred hardwood habitat would be increased due to the conversion of non-native pine-stands to native hardwoods.

The HSI model predicts that the beneficial effects of management activities would offset the loss of the mature timber and result in a higher HC for each of the mature-forest MIS. In the long term (50 years), the indirect effects of the HSI-modeled activities would result in an increased HC for each of the species. Scarlet tanager HC would be elevated almost 13 percent, wood thrush 16 percent and worm-eating warbler over 9 percent. Overall, implementation of Alternative 1 would indirectly and beneficially affect habitat quality and quantity for each mature-forest MIS, resulting in slight increases in local populations and population trends of these MIS.

b. Alternative 2

i. Early-Successional MIS

(yellow-breasted chat, northern bobwhite)

There could be some minimal, direct effects on early-successional MIS from the management practices and use activities under Alternative 2. Prescribed burns and other management practices for early-successional habitat would be conducted outside the typical nesting-season and any timber harvest would not affect existing early-successional habitat. Prescribed burns in early-successional habitats could reduce residual nesting-cover; but since these areas would be burned only periodically, residual cover would remain most years. The acreage of oldfield and grassland habitats would also be reduced over 50 years, as some areas would mature into oak-hickory upland habitat.

Implementation of this alternative would provide 7,400 acres of managed openland habitat for both species in the short and long terms, and 18,200 acres and 13,800 acres of early-successional hardwood habitat in the second and tenth decades, respectively. These habitats provide the optimum benefits for both species. The indirect effects would provide improved early-successional habitat conditions for the species in the short term (20 years). Both MIS would have elevated HC scores, up almost 13 percent for northern bobwhite and 26 percent for yellow-breasted chat. These increases are due to several factors, including the management of grasslands, oldfields and wildlife openings. Prescribed fire would stimulate the herbaceous groundcover, increasing diversity and promoting oak-hickory regeneration. The conversion of pine-stands to oak-hickory and some timber harvest by shelterwood cutting also would provide more early-successional habitat for MIS.

Over time, the indirect effects of management and use activities would result in an elevated HC for both species, up almost 12 percent for the northern bobwhite and 19 percent for the yellow-breasted chat, even though the acreage of early-successional habitat is reduced. Alternative 2 would provide less early-successional acreage in oldfield and grassland habitats than Alternative 1, but higher-quality habitats in the remaining grasslands and oldfields. In addition, early-successional habitats would be developed from the shelterwood timber harvest.

Overall, implementation of Alternative 2 would indirectly and beneficially affect habitat quality and quantity for each early-successional MIS, resulting in slight increases in local populations and population trends of these MIS.

ii. Mature-Forest MIS

(scarlet tanager, wood thrush, worm-eating warbler)

Alternative 2 would have some direct effects on mature-forest MIS. When mature trees are harvested in a shelterwood cut, it is possible for some individuals and/or nests to be lost in the process. This potential for loss is probably the highest for the scarlet tanager, which nests in the canopy of mature trees. The wood thrush nests in shrub-cover and the worm-eating warbler on the ground; thus, they are less likely to be directly affected by shelterwood harvests. Timber could be harvested throughout the year at scattered locations across the Forest, decreasing the possibility of adverse effects during the nesting season, the most vulnerable time for these MIS.

Implementation of this alternative would provide 200,900 acres and 186,300 acres of mature hardwood habitat in the second and tenth decades, respectively. These habitats in unfragmented areas provide the most benefit for all three species. This alternative would manage 137,800 acres outside of wilderness areas, Camp Hutchins, non-motorized areas and candidate wild and scenic river corridors to reduce fragmentation and benefit forest-bird diversity. The annual acreage proposed for shelterwood timber harvest in mature hardwoods in the first 20 years (short term) is approximately 870 of the 162,700 acres managed as even-aged and mature-hardwood forest (0.5 percent) (Spectrum Model runs, planning record). This harvest would affect only seven percent of the hardwood forest available for harvest and only four percent of the entire Forest. The Spectrum model indicates that, in the long term (100 years), about only 77,900 acres of mature hardwoods could be affected by timber harvest—48 percent of the hardwood forest available for harvest and 27 percent of the entire Forest.

Prescribed burns would be conducted in the early spring and late fall, outside the MIS nesting season and after seasonal migration from the area. No individuals are expected to be directly affected by prescribed fire. Thus, no direct effects on populations of mature-forest MIS are anticipated. Indirect effects could result from reductions in ground and shrub nesting-cover for worm-eating warblers and wood thrushes, respectively, immediately following a prescribed burn. The scarlet tanager, a canopy-nester, would not be indirectly affected. Because the burn areas would be rotated to provide residual cover and the burns scheduled before spring migration, or after the nesting/fledgling season in the fall, any adverse indirect effects on either species would be minimized.

Implementation of Alternative 2 would result in minimal direct effects on any of the mature-forest MIS. Indirect effects would result in more and higher-quality habitat and a higher HC for each species in the short term. Scarlet tanager HC would be elevated by almost 8 percent, wood thrush 15 percent and worm-eating warbler 2 percent. Even though these species are found in mature habitats, any adverse change in HC due to the loss of mature trees would be offset by the conversion of non-native pine stands to preferred, native hardwoods and the vegetative response to prescribed burns. The limited scale of the areas that would be managed with timber harvest could provide mature timber, while increasing the HC by providing a higher-quality habitat.

The HSI model predicts that the beneficial effects of management activities would offset the loss of the mature timber and result in a higher HC for each of the mature-forest MIS. In the long term (50 years), the indirect effects of the HSI-modeled activities would result in an increased HC for each of the species. Scarlet tanager HC would be elevated 13 percent, wood thrush 26 percent and worm-eating warbler 14 percent.

Overall, implementation of Alternative 2 would indirectly and beneficially affect habitat quality and quantity for each mature-forest MIS, resulting in an increase in local populations and population trends of these MIS.

c. Alternative 3

i. Early-Successional MIS

(yellow-breasted chat, northern bobwhite)

Alternative 3 allows very little active management of any type. The burning of approximately 10,000 acres, including maintenance of approximately 2,700 acres of barrens in natural areas, would maintain small amounts of early-successional and openland habitats. Some larger amounts of early-successional habitats would be present under this alternative in the short term, as former openlands succeed back to forest in the absence of management. At the same time, much of the existing, early-successional habitat would be reduced in quality as it succeeds to mid-successional hardwoods.

This alternative would provide no acreage of managed openland habitat for either species in the short and long terms. It would provide 21,600 acres and 5,700 acres of early-successional hardwood habitat in the second and tenth decades, respectively. These habitats provide the optimum benefits for both species. The indirect effects of Alternative 3 would result in a declining HC in the short term. Early-successional habitats are short-lived; however, and ten years without management would result in a 6-percent decrease in northern bobwhite HC and a decrease of 19 percent for yellow-breasted chats. The quality and quantity of early-successional habitats would decline as grasslands grow into brush-stands and oldfields become pole-sized timber-stands.

Due to the lack of management activities, most oldfields and grasslands—except for 3,900 acres of pasture at Dixon Springs and 2,700 acres of natural glades/barrens—would be lost in 50 years, unless more should be developed by natural events like tornadoes or wildfires. The

HC for the northern bobwhite and yellow-breasted chat would decline 16 percent and 60 percent, respectively, in the long term. Without management, there would be minimal early-successional habitat.

Overall, implementation of Alternative 3 would indirectly and adversely affect habitats and so result in decreases in both species, especially pronounced in the long term.

ii. Mature-Forest MIS

(scarlet tanager, wood thrush, worm-eating warbler)

Implementation of Alternative 3 would result in no direct effects on the mature-forest MIS because no habitat management would be allowed. This alternative would provide 200,600 acres and 261,100 acres of mature-hardwood habitat in the second and tenth decades, respectively. These habitats in unfragmented areas can provide the most benefit for all three species. By allowing no vegetation management, this alternative indirectly manages 137, 800 acres in 500-acre-or-larger blocks outside of wilderness areas, non-motorized recreational areas and candidate wild and scenic river corridors to reduce fragmentation. This alternative would result in minimal changes in HC for the mature-forest MIS during the first ten years, less than one percent elevation for the scarlet tanager and two percent for the worm-eating warbler. The HC for the wood thrush would decline 2.3 percent in the short term because of increased sub-canopy closure and a decreased stem-count on the forest floor resulting from a lack of sunlight.

In the long term, implementation of Alternative 3 would result indirectly in an elevated HC for each species, up 19 percent for the scarlet tanager, 11 percent for the wood thrush and 14 percent for the worm-eating warbler. A greater amount of mature habitat would be available as converted grasslands, oldfields and early-successional timber-stands mature. However, the overall quality of mature forests would decline without management due to conversion of much of the oak-hickory forest-type to maple-beech.

Overall, implementation of Alternative 3 would indirectly and beneficially affect habitat quantity, resulting in increases of local populations and population trends of the mature-forest MIS.

d. Alternative 4

i. Early-Successional MIS

(yellow-breasted chat, northern bobwhite)

Implementation of Alternative 4 would result in similar direct effects for the short and long term as those described for early-successional MIS under Alternative 2.

Implementation of this alternative would provide 23,500 acres of managed openland habitat for both species in the short and long terms, and 16,400 acres and 14,900 acres of early-successional hardwood habitat in the second and tenth decades, respectively. These habitats provide optimum benefits for both species. In the short term, indirect effects would result in an elevated HC for the early-successional species. In the short term, the HC for northern bobwhite and yellow-breasted chat would be elevated almost 13 percent and 25 percent, respectively. Alternative 4 management practices are very similar to Alternative 2 for bottomland, grassland and upland habitats, with management of oldfield habitats similar to that under Alternative 1. Due to the similarities of management under Alternatives 2 and 4, the changes in HC and the reasons for the changes are very similar.

Over the long term, indirect effects of Alternative 4 would elevate the HC 12 percent for northern bobwhite and 19 percent for yellow-breasted chat. The management activities under this alternative are very similar to those under Alternative 2, and the reasons for the changes in HC are listed in the long term, indirect effects section of Alternative 2.

ii. Mature-Forest MIS

(scarlet tanager, wood thrush, worm-eating warbler)

The direct effects of Alternative 4 on mature-forest species would generally be the same as those described under Alternative 2.

This alternative would provide 200,900 acres and 181,300 acres of mature-hardwood habitat in the second and tenth decades, respectively. These habitats in unfragmented areas provide the most benefit for all three species. This alternative would manage 141,500 acres outside of wilderness areas and candidate wild and scenic river corridors to reduce fragmentation and benefit forest-bird diversity. The annual acreage proposed for shelterwood timber harvest in mature hardwoods in the first 20 years (short term) would be approximately 750 of the 173,300 acres managed as even-aged and mature hardwood forest (0.4 percent) (Spectrum Model runs, planning record). This harvest in the first 20 years would affect only six percent of the hardwood forest available for harvest and only three percent of the entire Forest. The Spectrum model indicates that, in the long term (100 years), approximately 78,100 acres of mature hardwoods would be affected by timber harvest—45 percent of the hardwood forest available for harvest and 27 percent of the entire Forest.

In the short term, indirect effects of management practices would result in elevations of HC for all three species: 8 percent for the scarlet tanager, 15 percent for the wood thrush and 2 percent for the worm-eating warbler. Management activities under Alternative 4 would be the same as those of Alternative 2 in bottomland and upland habitats. Therefore, the indirect effects of Alternative 4 in the short termwould be the same as under Alternative 2.

In the long term, indirect effects of Alternative 4 would result in elevated HC for each of the mature-forest MIS: scarlet tanager up 7 percent, wood thrush up 19 percent and worm-eating warbler 8 percent. The reasons for these increases are the same as those described for the long term, indirect effects of Alternative 2.

Overall, implementation of Alternative 4 would indirectly and beneficially affect habitat quality and quantity, resulting in increases in local populations and population trends of the mature-forest MIS. Any loss of mature forest would be offset by gains in habitat quality and quantity for all three MIS, as the majority of hardwoods on the Forest continue to mature and maintain oak-hickory dominance.

2. Recreational Use of Roads and Trails, Dispersed Recreational Use, Developed Recreational Site Use

All Alternatives

Disturbances related to the recreational use of roads and trails, dispersed recreational use and developed recreational site use could result in the direct effect of disrupting some animals in high-traffic areas and some ground or shrub nests could be disturbed. However, implementation of any of the alternatives and protective standards and guidelines generally would result in minimal direct and indirect effects on populations of early-successional and mature-forest MIS.

There is a minor level of authorized ATV use on open roads and trails, primarily associated with the program for people with disabilities, and a moderate level of unauthorized ATV use. This authorized and unauthorized ATV use causes some disturbances that elicit physiological and behavioral responses from nearby wildlife species due to noise and surprise. Some species are very tolerant of these disturbances and have minimally adverse responses; others are not, and may be adversely affected by reductions in access to food or disruptions in breeding or parental care. Unauthorized ATV trails can cause some direct loss of terrestrial habitat for some species, but the amounts of loss are small.

Loss of, or effects on, aquatic habitats could be larger. The effects from ATVs on most birds, including the three MIS that nest in trees or shrubs, both in early-successional and mature forest habitats, would be minimal and localized to within a few feet of ATV routes. Effects on populations of these species would be unmeasurable. Ground-nesting birds and the MIS northern bobwhite and worm-eating warbler could be more-adversely affected; but, again, overall effects would be minimal and localized, with the overall effects unmeasurable, due to the low levels of adverse effects on individual animals and species.

3. Aquatic Resource Management and Mineral Resources Management

All Alternatives

Aquatic resource management and minerals management could cause direct and indirect, adverse effects at the time and place of the activity; but the adverse effects would soon diminish and, over time, have minimal effects on populations of early-successional and mature-forest MIS.

4. Land-Ownership Adjustment

All Alternatives

Land-ownership adjustment under any of the alternatives is expected to result in only minimal direct or indirect effects on any MIS. In general, local populations of northern bobwhite and chats on the Forest should benefit over time from the indirect effects on early-successional habitat quality and quantity.

5. Minerals Management

All Alternatives

Minerals management related to leasing actions under Alternatives 1, 2 and 4 could result in some adverse, generally indirect effects on migratory birds due to fragmentation if the canopy is opened in a forest-interior area for drilling and production facilities. These effects would not be widespread across the Forest, but localized in the more mineral-rich areas. However, any new lease of federally owned minerals would be subject to site-specific environmental analysis, during which possible effects on migratory birds can be reduced by limitations on the size and locations of any facilities. Under Alternative 3, the federal mineral estate is withdrawn, so no minerals management activity or effects are anticipated.

Implementation of minerals management under Alternatives 1, 2 or 4 could result in some adverse effects on migratory birds from mineral-leasing actions, primarily indirectly from fragmentation caused by opening the canopy for drilling and production facilities in forest-interior areas. These effects would not be widespread across the Forest, but localized in the more mineral-rich areas. However, any new mineral lease of federally owned minerals would be subject to site-specific environmental analysis, during which the effects on migratory birds can be reduced by limiting the size and locations of any facilities.

No development of federally owned minerals is allowed in wilderness areas. These areas include the largest, relatively unfragmented forested areas on the Forest and provide over 28,000 acres of habitat for many forest-interior species, which would remain unaffected by mineral-management actions. Surface occupancy for minerals management is not allowed under management prescriptions for the CR, CV, DR, HR, NA and WW management areas (54,000 acres) or within riparian areas and filter strips (approximately 20,000 acres) Forest-wide. This would prevent any possible adverse effects of mineral leasing and extraction on migratory birds in those areas. All the habitats, including forest-interior management areas within the MH and MO management areas (33,500 acres), have a limitation on surface use for the protection of migratory birds from April 1 to July 15. This would also limit noise and annual vegetation-management disturbances and their direct and indirect effects on nesting, migratory birds in these areas.

With compliance with all of these standards and guidelines and anticipated, limited and localized minerals management on the Forest, it is expected that federal mineral leasing and extractions would have only minimally adverse effects on migratory birds, including many forest-interior species, and have few overall effects on populations of migratory birds on the Forest. Tables 3-18a and 3-18b display projections of MIS wildlife habitat suitability and capability in 10 and 50 years, respectively, by alternative.

Table 3-18a. Forest-wide 10-year wildlife-habitat suitability/capability by alternative.

MIS	Present (03)		Alt. 1			Alt. 2			Alt. 3			Alt. 4		
	Mean HSI	HCU	Mean HSI	HCU	% Change	Mean HSI	HCU	% Change	Mean HSI	HCU	% Change	Mean HSI	HCU	% Change
Northern bobwhite	0.53	146093	0.56	156419	7.1	0.59	164888	12.9	0.49	136774	-6.4	0.59	164713	12.7
Scarlet tanager	0.52	131746	0.55	139138	5.6	0.56	142160	7.9	0.53	132320	0.4	0.56	142160	7.9
Yellow-breasted chat	0.27	72588	0.34	88742	22.3	0.35	91461	26.0	0.22	59168	-18.5	0.34	90695	24.9
Wood thrush	0.57	144329	0.62	155266	7.6	0.66	165507	14.7	0.56	140985	-2.3	0.66	165507	14.7
Worm-eating warbler	0.54	127267	0.54	127661	0.3	0.55	129786	2.0	0.55	129879	2.1	0.55	129786	2.0
Game Species														
White-tailed deer	0.68	188424	0.72	198995	5.6	0.71	197121	4.6	0.64	178509	-5.3	0.71	197026	4.6
Eastern wild turkey	0.65	182182	0.68	190038	4.3	0.69	191877	5.3	0.64	177198	-2.7	0.69	191657	5.2

Table 3-18b. Forest-wide 50-year wildlife-habitat suitability/capability by alternative.

MIS	Present (03)		Alt. 1			Alt. 2			Alt. 3			Alt. 4		
	Mean HSI	HCU	Mean HSI	HCU	% Change	Mean HSI	HCU	% Change	Mean HSI	HCU	% Change	Mean HSI	HCU	% Change
Northern bobwhite	0.53	146093	0.52	143684	-1.6	0.59	163180	11.7	0.44	123214	-15.7	0.59	164167	12.4
Scarlet tanager	0.52	131746	0.59	148431	12.7	0.56	148417	12.7	0.58	157307	19.4	0.56	140816	6.9
Yellow-breasted chat	0.27	72588	0.31	81148	11.8	0.32	86130	18.7	0.11	29294	-59.6	0.33	86359	19.0
Wood thrush	0.57	144329	0.66	166799	15.6	0.68	181529	25.8	0.59	159852	10.8	0.68	172318	19.4
Worm-eating warbler	0.54	127267	0.59	139285	9.4	0.58	145322	14.2	0.57	144734	13.7	0.58	137468	8.0
Game Species														
White-tailed deer	0.68	188424	0.70	194745	3.4	0.74	204764	8.7	0.63	175999	-6.6	0.74	204865	8.7
Eastern wild turkey	0.65	182182	0.65	179503	-1.5	0.74	205205	12.6	0.60	168048	-7.8	0.74	205028	12.5

CUMULATIVE EFFECTS ON MIS

This discussion of cumulative effects takes into consideration the past, present and reasonably foreseeable future actions specified at the beginning of Chapter 3.

The principal actions affecting early-successional MIS on private lands and the Forest are agricultural activities, the allowance of tall-fescue cover in grasslands and oldfields, the succession of oldfields to dense shrub-thickets and/or mid-aged hardwood forests, timber harvest, the lack of timber harvest, prescribed fire and the lack of prescribed fire in both fields and forest edges. The IDNR currently works cooperatively with private landowners to implement some prescribed fire of fields and forests and expects to expand the program in the future.

The principal actions affecting mature-forest MIS on private lands and the Forest are agricultural activities, including the clearing of timbered land for additional fields, the succession of oldfields to early-successional and mid-aged hardwood forests, timber harvest, the lack of timber harvest, a limited amount of mineral exploration in forested areas, and prescribed fire or the lack of burning in hardwood forests. The IDNR currently works cooperatively with private landowners to implement some prescribed fire of forests and expects to expand the program in the future.

1. Alternative 1

a. Early-Successional MIS

(yellow-breasted chat, northern bobwhite)

Northern bobwhite and yellow-breasted chat populations are declining locally and regionally. Even though the long-term model indicates that the HC would be elevated on the Forest for the yellow-breasted chat and decreased slightly for the northern bobwhite, the benefits of these changes are likely to be overwhelmed by the adverse effects of land-use practices on surrounding private lands. The leading cause of the decline of these species is habitat-loss, mainly the loss of grassland and shrub habitat on private lands and the cover and food they provide. Other factors contributing to the decline of the northern bobwhite are fire-suppression and “clean-farming” practices that lead to larger fields with less crop residue, fewer fencerows and associated cover, and more fescue pastures in place of native grasses (Roseberry and Klimstra, 1984; Brennan, 1991; Robbins, 1991; Barnes *et al.*, 1995 and Brennan, 1999). Under Alternative 1, the total acreage of early-successional habitats, including experiment-station pastures, herbaceous openlands, wildlife openings and oldfields is about 26,300 acres, or nine percent of the Forest.

Prior to 1995, the management of large openlands was limited to three areas totaling about 1,400, and 100 acres of wildlife openings, some of which were included in the large openland areas. An openland-management plan was implemented recently that includes management of 2,700 acres in 13 large openlands across the Forest, affecting about 400 acres to date. Populations of both species on the Forest have increased in these managed areas, but, regionally, the populations are still decreasing.

Considering past, present and reasonably foreseeable future actions and effects on these species and their habitat, both on and near the Forest, the actions proposed under this alternative are expected to result cumulatively in minimal, beneficial effects on the early-successional MIS: existing populations would be maintained with a small overall increase on the Forest or in the region.

b. Mature-Forest MIS

(scarlet tanager, wood thrush, worm-eating warbler)

Scarlet tanager and worm-eating warbler populations are fairly stable, with some shifting of historic and current distribution. Wood thrush populations, however, have been declining in most of their range, primarily due to habitat-loss and fragmentation. Lands within the Forest proclamation boundary are no exception to the trend of increased fragmentation and habitat-loss on private lands. Land purchase for forestland consolidation is planned currently and is expected to continue in the future. Some mineral exploration-related actions could cause minimal forest fragmentation in the future.

The proclamation boundary encompasses over 840,000 acres, about 284,600 acres of which are managed by the Forest Service. This land is not contiguous, but a patchwork of public and private parcels. The remaining 556,000 acres of private land are a mixture of agricultural, forested and developed land. With the majority of habitat within the proclamation boundary on private land, the mitigation of habitat-loss and fragmentation by the Forest alone is not possible. The Nature Conservancy is working to reduce private land-management effects on adjacent blocks of national forest in some key areas. Together with improvements in habitat quantity and quality on the Forest, this could result in some overall, net beneficial effects on populations of these MIS on the Forest and in southern Illinois.

Considering past, present and reasonably foreseeable future actions and effects on these species and their habitat, both on and near the Forest, the actions proposed under this alternative are expected to result cumulatively in minimal effects on the mature-forest MIS, even though habitat conditions would improve on the Forest. Irrespective of habitat improvements on and near the Forest, distant effects on the wintering-ground habitats of some MIS could have adverse effects on populations. Barring such effects, however, it is anticipated that existing mature-forest MIS populations would be maintained, with little or no overall increase on the Forest or in the region.

2. Alternatives 2 and 4

a. Early-Successional MIS

(yellow-breasted chat, northern bobwhite)

Northern bobwhite and yellow-breasted chat populations are declining both regionally and locally. Prior to 1995, the management of large openlands was limited three, with about 1,400, and 100 acres of wildlife openings, some of which were included in the large openland areas. An openland-management plan was implemented recently that includes management of 2,700 acres in 13 large openlands across the Forest, affecting about 400 acres to date. Populations of both species on the Forest have increased in these managed areas, but, regionally, the populations are still decreasing.

Even though the HC for bobwhite and yellow-breasted chat would be elevated substantially as a result of implementing either Alternative 2 or 4, the benefits of these changes would likely be overshadowed by land-use practices on surrounding private lands. Habitat-loss is the leading cause of the decline of these two species. Other factors in the decline of bobwhite populations are fire-suppression and “clean-farming” practices (Roseberry and Klimstra, 1984; Brennan, 1991; Robbins, 1991; Barnes *et al.*, 1995 and Brennan, 1999). It is anticipated, however, that there will be an increase in prescribed fire on private lands near the Forest.

Considering past, present and reasonably foreseeable future actions and effects on these species and their habitat, both on and near the Forest, the actions proposed under either of these alternatives are expected to result cumulatively in minimal, beneficial effects on the early-successional MIS. Even though local populations of the bobwhite and chat could increase on and around managed areas of the Forest, no general increase is anticipated, due mainly to the non-beneficial activities on surrounding private land.

b. Mature Forest MIS

(scarlet tanager, wood thrush, worm-eating warbler)

The past, present and reasonably foreseeable future actions on private lands within the Forest boundary would be the same as those discussed in the introduction to this cumulative effects analysis and in the discussion of the cumulative effects on mature-forest MIS under Alternative 1. It is, therefore, doubtful that the management actions of either Alternative 2 or 4 would have a notable effect on populations beyond the local scale, due to the large proportion of privately owned lands near the Forest and the continued, adverse effects of activities on those lands.

The Forest would likely harbor the “source” population for the majority of the MIS in southern Illinois, because of the benefits of land consolidation and the proposed Plan’s forest-interior management guidelines. When the quality habitat on the Forest reaches its carrying-capacity and birds move out to nest on private lands, they will be moving into sub-optimal habitats with very little recruitment, also known as population “sinks.” Continued decline in the conditions of the wintering grounds of many Neotropical migrants would also continue to suppress some of the beneficial effects of management on the Forest.

Considering past, present and reasonably foreseeable future actions and effects on these species and their habitat, both on and near the Forest, the actions proposed under either of these alternatives are expected to result cumulatively in minimal, beneficial effects on Forest populations of the mature-forest MIS, and no measurable effect on region-wide populations.

3. Alternative 3

a. Early-Successional and Mature-Forest MIS

(yellow-breasted chat, northern bobwhite, scarlet tanager, wood thrush, worm-eating warbler)

Implementation of Alternative 3 would result in a decline in HC for the early-successional MIS, modest gains for two mature-forest MIS, the scarlet tanager and worm-eating warbler, and a small loss for the wood thrush on the Forest. After 50 years, all three species would have elevated HCs due to the increased acreage of mature habitat. Alternative 3 would eliminate early-successional habitat, reducing the amount of oak and hickory, providing a high-density canopy and decreasing the penetration of light to the ground (Fralish, 1997; Fralish *et al*., 2002). Considering past, present and reasonably foreseeable future actions and effects on these species and their habitats, both on and near the Forest, the actions proposed under this alternative are expected to result cumulatively in minimal effects on the MIS, maintaining populations, with no measurable effect on region-wide populations. Table 3-19 presents a summary of effects on MIS by alternative.

Table 3-19. Summary of effects on MIS habitats and populations by alternative.

MIS	Alternative 1 Cumulative effects	Alternative 1 Population-trends on the Forest	Alternative 2 Cumulative effects	Alternative 2 Population-trends on the Forest	Alternative 3 Cumulative effects	Alternative 3 Population-trends on the Forest	Alternative 4 Cumulative effects	Alternative 4 Population-trends on the Forest
Northern bobwhite	7 % increase in habitat quality and quantity	Stable-slightly increasing	13% increase in habitat quality and quantity	Stable-slightly increasing	6 % decrease in habitat quality and quantity	Slight decline	13% increase in habitat quality and quantity	Stable-slightly increasing
Yellow-breasted chat	22% increase in habitat quality and quantity	Stable-slightly increasing	26% increase in habitat quality and quantity	Stable-slightly increasing	19% decrease in habitat quality and quantity	Slight decline	25% increase in habitat quality and quantity	Stable-slightly increasing
Wood thrush	8% increase in habitat quality and quantity	Stable-slightly increasing	15% increase in habitat quality and quantity	Stable-slightly increasing	2% decrease in habitat quality and quantity	Stable	15% increase in habitat quality and quantity	Stable-slightly increasing
Worm-eating warbler	No change in habitat quality and quantity	Stable	2% increase in habitat quality and quantity	Stable	2% increase in habitat quality and quantity	Stable-slightly increasing	2% increase in habitat quality and quantity	Stable
Scarlet tanager	6% increase in habitat quality and quantity	Stable	8% increase in habitat quality and quantity	Stable	No change in habitat quality and quantity	Stable-slightly increasing	8% increase in habitat quality and quantity	Stable

2. SPECIES WITH VIABILITY RISK

Table 3-20 displays the plant and animal species and their respective habitats identified during the viability-evaluation process to have possible viability risks on the Hoosier and/or Shawnee National Forests and to be indicators of biodiversity. Because the two Forests share much of the same ecological land-types and land-type associations, they also share many of the same plant and animal species (McCreedy et al., 2004). The two Forests coordinated the initial viability evaluations and the selection of the indicators (Appendix E). All species selected have been declining on both Forests and throughout their ranges in the Central Hardwood Region of the United States (McCreedy et al., 2004).

Table 3-20. Rare or declining animal species/indicators and the communities/habitats on the Forest with which they are associated.

Community/Habitat Association Common Name	Status*	Community/Habitat Association Common Name	Status*
Forest/Dry-Upland Forest		**Barrens/Limestone**	
Northern bobwhite	MIS	Northern bobwhite	MIS
Worm-eating warbler	MIS	Yellow-breasted chat	MIS
Redheaded woodpecker		Indiana bat	E (SE)
Indiana bat	E (SE) MIS	Eastern woodrat	RFSS (SE)
Eastern woodrat	RFSS (SE)	Timber rattlesnake	RFSS (ST)
Timber rattlesnake	RFSS (ST)	Prairie parsley	
Short-leafed pine	T (SE)	Yellow gentian	RFSS
Rhododendron		Climbing milkweed	RFSS (ST)
Carolina thistle		Buffalo clover	(SE)
Mead's milkweed	T (SE)	Pink milkwort	(SE)
Forest/Mesic Forest		**Cliffs/Moist Sandstone**	
Cerulean warbler	RFSS	Eastern woodrat	RFSS (SE)
Wood thrush	MIS	Timber rattlesnake	RFSS (ST)
American woodcock		French's shooting star	RFSS
Indiana bat	E (SE)	New York fern	RFSS (SE)
Black cohosh	RFSS (SE)		
Illinois wood sorrel	RFSS (SE)		
Ovate catchfly	RFSS (SE)		
Superb lily			
Cultural/Openland/Brushland		**Wetlands/Swamp**	
Henslow's sparrow	RFSS (SE)	Indiana bat	E (SE)
Northern bobwhite	MIS	River otter	(ST)
Yellow-breasted chat	MIS	Spring cavefish	
American woodcock		Cypress-knee sedge	(SE)
Indiana bat	E (SE)		
Barrens/Sandstone		**Barrens/Gravel**	
Indiana bat	E (SE)	Yellow-breasted chat	MIS
Eastern woodrat	RFSS (SE)	Pink milkwort	(SE)
Timber rattlesnake	RFSS (ST)	Prairie parsley	
Mead's milkweed	T (SE)	Carolina thistle	
Ofer hollow reed-grass	RFSS (SE)		
Carolina thistle			
Prairie parsley			
Cliffs/Dry Sandstone			
Eastern woodrat	RFSS (SE)		
Timber rattlesnake	RFSS (ST)		

* E=federally listed endangered species; T=federally listed threatened species; RFSS=Regional Forester sensitive species; SE=state-listed endangered species; ST=state-listed threatened species; MIS=management indicator species

DIRECT AND INDIRECT EFFECTS ON SPECIES WITH VIABILITY RISK

1. Redheaded Woodpecker

This is a cavity-dependent, bird species on the Forest that utilizes open, upland and bottomland, oak woodlands and forests with many dead trees for nesting and foraging. It is relatively common in bottomland, oak-dominated forests on the west side of the Forest. Since all standing, dead trees are protected in the Plan Forest-wide standards and guidelines under all alternatives, primarily for Indiana bats, no direct effects on the redheaded woodpecker are anticipated. The species would benefit indirectly from effects on its habitats from restrictive management; timber harvest and prescribed fire to maintain oak-hickory forests in both the uplands and bottomlands of mature forest areas and the Oakwood Bottoms Greentree Reservoir; vegetation treatment and prescribed fire in natural areas, Oakwood Bottoms Greentree Reservoir and the Big Muddy River candidate wild and scenic river corridor; and implementation of the Plan standards and guidelines that maintain and manage snags and cavity trees throughout the Forest. All of these activities promote habitat management favorable for maintaining oak forests and woodlands and dead trees and, thus, are favorable for the species.

Implementation of Alternative 2 or 4 would result in the maintenance of more oak-hickory forest in both the uplands and bottomlands, and more open oak woodlands, than would Alternative 1 or 3 and, thus, would have greater, beneficial, indirect effects on this species. Alternative 2 or 4 would do this by providing the most timber harvest and prescribed fire of the four alternatives. Alternative 3 is the least favorable for the species due to its lack of timber harvest and a lesser degree of prescribed fire in oak forests and woodlands.

2. American Woodcock

The American woodcock is a species dependent on wet areas in hardwood forests, oldfields and grasslands for foraging, and early-successional areas in forests and oldfields for nesting on the Forest. The species has always been considered an uncommon nesting species in Illinois and on the Forest (Owen *et al.*, 1977 and Illinois Breeding Bird Atlas, 1998).

Under any alternative, this species would benefit indirectly through effects on its habitats from restrictive management; timber harvest and prescribed fire to maintain early-successional, hardwood forests in both the uplands and bottomlands in the even-aged hardwood and mature forest management areas and the Oakwood Bottoms Greentree Reservoir; and openings and openlands management. Vegetation disturbances that create areas of early-successional forests in these areas are beneficial for this species.

All four alternatives would protect riparian habitats and limit disturbances in riparian filter strips and candidate wild and scenic river corridors. Alternatives 1, 2 and 4 would allow some burning and limited amounts of forest management in candidate wild and scenic river corridors and filter-strips and moderate amounts of timber harvest and prescribed fire in hardwood forests in the even-aged hardwood and mature forest management areas and the Oakwood Bottoms Greentree Reservoir. They would offer the most beneficial, indirect effects on American woodcock populations and habitats, with the greatest degree of benefit expected from Alternatives 1 and 4, in proportion to the amount of managed early-successional hardwood forests and oldfields. Alternative 3 would allow the least management activities and vegetation disturbances, including burning and timber harvest, in all management areas and, so, have the least beneficial, indirect effects on American woodcock populations and habitats.

3. River Otter

The river otter is a species dependent upon wetlands and perennial streams, rivers, lakes and reservoirs for foraging and denning habitat. It would benefit from the effects on these habitats under any of the alternatives. The species would not be directly or indirectly affected by openings and openlands management, vegetation treatments, or dispersed or developed recreation use. Under any of the alternatives, restrictive management in riparian areas and in water-supply watersheds and aquatic resources management would maintain and improve habitats through limitations on disturbances that could adversely affect water quality and/or through wetland-restoration. This would have direct and indirect beneficial effects.

Under Alternative 2 or 3, seasonal trail and road closures could occur and cross-country equestrian use would not be allowed. This would further reduce any minor, indirect effects on water quality and river otter habitats under these alternatives, versus Alternative 1 or 4, which would allow all-season and cross-country equestrian use. Authorized and unauthorized ATV use would occur under any alternative. However, no measurable declines in populations or in habitats are expected from these activities under any of the alternatives. Under any alternative, land-ownership adjustments that would include perennial water sources and/or wetlands would allow for maintenance and improvement of these habitats and have beneficial, indirect effects on the species.

River otters and their habitats could also be affected indirectly and adversely by integrated pest management, roads and trails management and use, timber harvest, fire management and minerals management. Roads and trails management and use, timber harvest and fire and minerals management would all cause some level of vegetation and soil disturbances and, thus, have the ability to increase erosion and sedimentation in water bodies, habitats utilized by the otters. However, these possible effects would be greatly lessened under all alternatives by the application of filter-strip standards and guidelines. Under Alternative 1, these guidelines result in narrower filter strips on steep slopes and thus are somewhat less protective than under Alternative 2, 3 or 4. Alternative 1 thus could have more minor, adverse, indirect effects on the otter than the other alternatives.

Integrated pest management, associated primarily with non-native fish species control and management, could indirectly and adversely affect the river otter, as fish and other aquatic forages may be reduced in some areas. However, this would be a very limited action and a restrictive activity. Pesticides utilized with this activity would be applied to EPA standards. Therefore, few if any measurable effects on river otters would occur from this activity under any of the alternatives.

4. Spring Cavefish

This is a fish species with limited distribution and numbers across the Forest. It is associated with karst geology and associated caves and perennial springs, which provide habitat for feeding and reproduction. Under all alternatives, compliance with Forest-wide standards and guidelines for the protection of springs and seeps and caves should protect the species and its habitats from any degradation, no matter the activity. Most of the largest springs and caves with spring cavefish populations are also protected and managed as part of the restrictive management in natural areas and research natural areas.

However, a few known sites for the species are being adversely affected by unauthorized ATV-use and road and road culvert management. These activities have the potential to substantially affect local populations at each site, but have not had such pronounced effects to date at any of the locations. Direct and indirect effects on spring cavefish and their habitats from roads and trails management and use are adverse but minor. However, under any alternative, compliance with standards and guidelines would mitigate these effects. All other management activities under any of the alternatives would not affect the species, since springs and caves would be protected.

5. Carolina Thistle

This is a plant species found in sandstone and limestone barrens and in dry-upland forests. Most populations of the species on the Forest are in natural areas and should be measurably affected only by restrictive, natural area management, prescribed fire, vegetation treatments like tree and shrub thinnings and land-ownership adjustment. However, the introduction and/or dispersal of non-native invasive species and their direct and indirect effects on this species are a concern under all alternatives.

The species in the past has responded favorably to natural-area management and activities, such as prescribed fire and tree and shrub thinnings/removals. Each alternative includes these management activities in natural areas and would result in beneficial, direct and indirect effects on the species. Because Alternatives 1, 2 and 4 also include these activities in areas adjacent to natural areas, they would be more beneficial for the species than Alternative 3. These additional actions under Alternatives 1, 2 and 4 would allow the species to expand its range and populations beyond natural areas into improved habitats. Alternatives 2 and 4 would include more burning outside of natural areas than Alternative 1, and would be the most beneficial for the species.

Under any alternative, land-ownership adjustment that includes the acquisition of high-quality barrens and dry-upland forests would enable additional habitat maintenance and improvement and so have a beneficial effect on the species.

6. Pink Milkwort and Prairie Parsley

These are species of sandstone, limestone and gravel barrens known only from natural areas on the Forest. Activities that could affect these species include restrictive management, fire management, roads and trails use and management, vegetation treatment and land-ownership adjustment. All other management activities under all four alternatives are not expected to affect either of the species.

Restrictive—natural area—management, prescribed fire, vegetation treatment with selective tree and shrub thinnings and land-ownership adjustments have all been done in the past with indirect, beneficial effects on both species and their barrens communities. Increases in numbers and flowering individuals of all three species have been documented following barrens management actions in natural areas (SNF Monitoring Reports, 1992-2002). Past acquisition of barrens communities by the Forest has allowed for management to maintain and improve the communities on the acquired lands. All these actions could be done in barrens-dominated natural areas under any alternative and, thus, effects on both species would be similar under any alternative.

Recreational trail use has directly and adversely affected the species in a few locations, primarily from unauthorized equestrian and/or ATV-use in its natural-area habitat. To date, these activities are rare and have had minor effects on local populations. Each alternative includes restrictions on recreational use and management actions in natural areas near protected populations and, thus, direct effects on the species from trail use and management are expected to be minor and adverse and similar under each alternative. However, under all alternatives, the introduction and/or dispersal of non-native invasive species and their effects on these species are a concern.

7. Shortleaf Pine and Rhododendron

These are species of dry-upland forest in the LaRue-Pine Hills/Otter Pond Research Natural Area. Shortleaf pine is a shade-intolerant species (Lawson 1990) and rhododendron is an associate of the pine throughout much of its range (Lawson 1990). Prescribed fire and maintenance of open-canopy conditions is known to benefit shortleaf pine and pine-reproduction in all other parts of its native range (Lawson 1990). Infrequent prescribed burns in Pine Hills have had mixed results for both species; neither has increased or decreased.

Management actions like prescribed fire and selective tree and shrub thinnings have been and will continue to be specified for the south-, west- and southwest-facing slopes in the Pine Hills Research Natural Area. These actions can benefit shortleaf pine and associates and improve reproduction of the populations when applied on a regular basis. Restrictive management, fire management and vegetation treatments are the only activities under all alternatives that could affect the species, and these direct and indirect effects are expected to be beneficial for both species under all alternatives. Table 3-21 presents a summary of effects on species with viability risks in decades 2 and 10.

Table 3-21. Summary of effects on habitats of species with viability risk in decades 2 and 10 (unless otherwise indicated).

Species	Habitat-Indicator*	Alt. 1	Alt. 2	Alt. 3	Alt. 4
Redheaded woodpecker	Acres of open, oak woodland	15,000 15,000	76,200 76,200	10,000 10,000	74,900 74,900
	Acres of oak-hickory–dominated bottomland forests	6,300 8,300	6,300 8,300	6,300 8,300	6,300 8,300
	Acres of oak-dominated upland forest	186,700 176,400	189,900 192,400	192,400 131,400	188,000 190,300
	Acres of open, hardwood forests (0-60% canopy closure)	81,100 37,500	78,000 62,200	77,700 36,200	78,900 64,900
American woodcock	Acres of early-successional (0-20 years old) hardwood forests	16,400 7,000	18,200 13,800	21,609 5,700	16,400 14,900
	Acres of managed grasslands, oldfields, wildlife openings	23,500 23,500	7,400 7,400	0 0	23,500 23,500
River otter	Miles of managed perennial streams	150	150	150	150
	Acres of managed swamps—all existing and future acres	About 1,100-2,000	About 1,100-2,000	About 1,100-2,000	About 1,100-2,000
Spring cavefish	Managed springs and seeps—total number	Includes 16 large springs	Includes 16 large springs	Includes 16 large springs	Includes 16 large springs
Carolina thistle, pink milkwort, prairie parsley	Acres of managed barrens communities	2,700 2,700	2,700 2,700	2,700 2,700	2,700 2,700
Carolina thistle	Acres of prescribed fire	15,000 15,000	76,200 76,200	10,000 10,000	74,900 74,900
Shortleaf pine, rhododendron	Acres of managed LaRue-Pine Hills/Otter Pond Research Natural Area	2,811	2,811	2,811	2,811

* From Tables 2-2 and 3-37

CUMULATIVE EFFECTS ON SPECIES WITH VIABILITY RISKS

This discussion of cumulative effects takes into consideration the past, present and reasonably foreseeable future actions specified at the beginning of Chapter 3, principally the actions discussed below.

The principal actions affecting the species of grasslands, barrens and woodlands on private lands and the Forest are agricultural activities, including grazing and mowing, the allowance of tall-fescue cover in grasslands and oldfields, proliferation of non-native invasive species, succession of oldfields to dense shrub-thickets and/or mid-aged hardwood forests, timber harvest, the lack of timber harvest, and prescribed fire or the lack of prescribed fire in grasslands, fields, barrens, woodlands and forest edges. The IDNR currently works cooperatively with private landowners to implement some prescribed fire of natural areas with barrens and woodlands, grasslands, fields and hardwood forests and expects to expand the program in the future.

The principal actions affecting the species of mature forests on private lands and the Forest are agricultural activities, including the clearing of timbered land for additional fields, the succession of oldfields to early-successional and mid-aged hardwood forests, timber harvest, the lack of timber harvest, a limited amount of mineral exploration, and prescribed fire or the lack of burning in hardwood forests. The IDNR currently works cooperatively with private landowners to implement some prescribed fire of forests and expects to expand the program in the future.

1. Redheaded Woodpecker

Both upland and bottomland oak forests and woodlands would continue to age and be replaced by maple-beech forests in the future without a moderate amount of timber management and harvest, other vegetation treatments, such as timber-stand improvement and reforestation, and prescribed fire to maintain the oaks. Oak-woodland nesting and wintering habitats for the redheaded woodpecker have decreased drastically throughout the range of the species, including southern Illinois, due to firewood-cutting, land-clearing, fire suppression and "clean-farming" practices (Smith *et al*., 2000).

Open forest and woodland conditions have decreased on the Forest in recent years as forests continued to mature and minimal forest management has occurred. This trend is expected to continue on private lands, but would vary on the Forest depending on the alternative selected. Alternatives 2 and 4 would provide the greatest amount of managed oak woodlands as a result of both timber harvest and prescribed fire. Alternative 1 or 3 would provide fewer acres of oak woodlands.

Considering past, present and reasonably foreseeable future actions and effects on these communities, both on and near the Forest, the actions proposed under any of the alternatives are expected to result cumulatively in generally minimal to unmeasurable, beneficial effects on habitats of the red-headed woodpecker on the Forest and in southern Illinois. Although populations would be maintained or increase from current levels under Alternative 2 or 4 and slightly decrease under Alternative 1 or 3, viable populations would be maintained under all alternatives.

2. American Woodcock

The acreage of early-successional forest and oldfields has decreased on private lands in southern Illinois (Schmidt *et al*., 1998) and on the Forest (Haugen, 2003) as forests and fields continue to mature. This trend is expected to continue on private land in the vicinity of the Forest. The trend on the Forest would vary by alternative.

Considering past, present and reasonably foreseeable future actions and effects on this species, both on and near the Forest, the actions proposed under any of the alternatives are expected to result in cumulative effects on breeding and wintering woodcock populations on and near the Forest that are similar to habitat trends, with either Alternative 1 or 4 maintaining the most habitat and, thus, maintaining or slightly increasing existing breeding and wintering populations. Alternative 2 would maintain fewer managed openlands in the long term and, thus, would maintain existing populations or produce lesser increases than under Alternative 1 or 4. Regional populations are expected to decrease slightly under Alternative 3, due to reductions in both early-successional forest and managed oldfields and grasslands. This alternative may not be able to maintain viable populations of the woodcock.

3. River Otter

Riparian land use and habitat-condition have been shown to be the most important determinants of water quality and biotic integrity influencing the movement of water, sediments and nutrients and so, too, habitats in streams, rivers and reservoirs (Whiles and Garvey, 2004). The riparian habitats of most of the watersheds of the Forest are less than 75 percent forested; more than half near the Forest are in agriculture. However, because the Forest protects the riparian habitats and water quality of all of its perennial streams, many stream sections on the Forest have been identified as good habitat, with high water-quality and biological integrity, including most of the candidate wild and scenic river corridors (Hite *et al*., 1990). The IDNR is currently developing partnership improvement plans for many of the important watersheds and ecosystems near the Forest.

Considering past, present and reasonably foreseeable future actions and effects on this species, both on and near the Forest, the actions proposed under any of the alternatives are expected to result cumulatively in beneficial effects on the river otter. Populations would be maintained or slightly increase from current levels due to improvement of habitat quality.

4. Spring Cavefish

Past, present and future actions affecting springs and caves on or near the Forest are discussed in the cumulative effects section for ecological communities and habitats. Some unauthorized ATV use is having some slight negative effects on one population of this species on the Forest, but this is expected to decrease in the future under all alternatives with more management attention. Overall, considering past, present and reasonably foreseeable future actions including those to protect and improve habitats for the species, both on and off the Forest, implementation of any of the alternatives would result in beneficial cumulative effects on spring cavefish. Populations would be maintained or slightly increased from current levels.

5. Carolina Thistle, Pink Milkwort, Prairie Parsley

Past, present and future actions in barrens communities and habitats on or near the Forest are discussed above in the cumulative effects section on ecological communities and habitats. Considering past, present and reasonably foreseeable future actions, both on and near the Forest, implementation of any of the alternatives would result in beneficial, cumulative effects on these plants. Populations would be maintained or increased from current levels under Alternatives 1, 2 or 4; populations would generally remain stable, with little increase, under Alternative 3.

6. Shortleaf Pine and Rhododendron

The dry, upland-forest communities of the Pine Hills Research Natural Area that are habitats for shortleaf pine and rhododendron within the Forest boundary were harvested, grazed and burned as part of early European settlement and subsequent agricultural management in the 19th and early 20th century (LaRue-Pine Hills/Otter Pond Research Natural Area Establishment Report, 1988). The Pine Hills Research Natural Area became part of the Forest in the late 1930's and has been managed since then to maintain the unique biodiversity of the area, including the native shortleaf pine from which the area gets its name. Management in the late 1980's and early 1990's included prescribed fire to promote the native pine and associated rhododendron habitats. Under any alternative, management of the RNA would continue.

Considering past, present and reasonably foreseeable future actions, both on and off the Forest, implementation of any of the alternatives would result in beneficial, cumulative effects on these plants. Populations would be maintained or increased from current levels.

3. FEDERALLY LISTED THREATENED AND ENDANGERED SPECIES

Several species federally listed as threatened or endangered have ranges that include land within the Forest proclamation boundary. They are:

Endangered:

Gray bat (*Myotis grisescens*)
Indiana bat (*Myotis sodalis*)
Least tern (*Sterna antillarum*)
Pallid sturgeon (*Scaphirhynchus albus*)
Fanshell mussel (*Cyprogenia stegaria*)
Fat pocketbook pearly mussel (*Potamilus capax*)
Pink mucket pearly mussel (*Lampsilis abrupta*)
Orange-footed pearly mussel (*Plethobasus cooperianus*)

Threatened:

Bald eagle (*Haliaeetus leucocephalus*)
Mead's milkweed (*Asclepias meadii*)

Of these, only the Indiana bat, gray bat, bald eagle and Mead's milkweed are currently or historically known from the Forest. Implementation of any of the proposed alternatives could affect these four species and their habitats. The least tern, pallid sturgeon, fanshell mussel, fat pocketbook pearly mussel, pink mucket pearly mussel and orange-footed pearly mussel all occur in or by the Mississippi and Ohio Rivers that border the Forest. Implementation of any of the proposed alternatives could indirectly affect these six species and their habitats.

The Endangered Species Act requires our protection of all species listed by the US Fish and Wildlife Service as threatened or endangered and their habitats. National forests are charged with management for the recovery of the species in accordance with federal recovery plans. Accordingly, all potentially adverse effects of Forest uses and actions on these species must be avoided or reduced to minimal, unmeasurable effects on individual animals, their local populations, their habitats and/or their potential habitats under all alternatives.

Forest-wide standards and guidelines have been developed for each species or group of species in order to eliminate, or reduce to discountable levels, potentially adverse effects, and to promote active management to maintain or improve their habitats. These standards and guidelines would be applied under all alternatives. The alternatives have been designed to mitigate adverse effects and create an overall beneficial outcome for threatened or endangered species.

DIRECT AND INDIRECT EFFECTS ON FEDERALLY LISTED THREATENED AND ENDANGERED SPECIES

Management of known Indiana bat hibernacula and maternity colonies and roost trees, bald eagle nest-sites and trees and winter roost-sites and trees, and population sites of Mead's milkweed would be protected, maintained and improved if possible as a result of implementing Forest-wide standards and guidelines. There are four known Indiana bat hibernacula on the Forest and six within the Forest boundary. The largest are on the Forest. These are jointly managed with IDNR, and all riparian filter strips and riparian habitats would be managed to protect and improve habitat conditions and to maintain and improve water quality under all alternatives. Compliance with Forest-wide standards and guidelines would benefit riparian and aquatic species, including threatened and endangered species on the Forest and downstream in the watersheds.

1. Restrictive Management

a. Alternative 1

Restrictive management under Alternative 1 would affect approximately 38 percent (108,600 acres) of the Forest. In these restrictively managed areas—except for approximately 3,000 to 5,000 acres of natural areas—there would be limited or no timber or other vegetation-management activities. Most of these areas would be allowed to succeed to mature forest with old-growth forest conditions. Prescribed fire could occur in some of the areas and could affect understory diversities in some locations.

Future old-growth forests would be dominated by beech and maple, with oak and hickory greatly reduced from present numbers. They would have dense canopies and midstories, with minimal herbaceous-understory diversity. Maturing forest stands would have more large trees and snags than younger stands. These habitat changes would indirectly affect Indiana bats, gray bats, bald eagles and Mead's milkweed and have no measurable effects on the least tern, pallid sturgeon, fanshell mussel, fat pocketbook pearly mussel, pink mucket pearly mussel and orange-footed pearly mussel.

i. Indiana bat

These (existing and future) conditions would offer some roosting-habitat benefits for Indiana bats in mature and old-growth hardwood forests. However, dense canopies in many of these restrictively managed areas would represent a decline in the quality and quantity of foraging habitats that could offset the benefits to the bats. Additionally, existing oak-hickory forests that include many roosting and foraging habitats preferred by Indiana bats would be greatly reduced. Overall benefits to Indiana bats of restrictive management under Alternative 1 would result from minimal, indirect effects on roosting habitat.

ii. Gray bat

No gray bats have been identified on the Forest since the late 1980's, although their occurrence is documented adjacent to the Forest. Restrictively managed areas are generally locations of potential foraging habitats for the bats, especially the corridors of candidate wild and scenic rivers. Management would continue to protect these areas and to generally restore forests and/or promote old-growth forest management in riparian habitats. This should indirectly benefit gray bats by improving potential foraging habitats in both the short and long term. However, any indirect, beneficial effects on individuals and local populations of gray bats have been and would continue to be minor.

iii. Bald eagle

Restrictive-management areas are generally where most bald-eagle nesting and wintering presently occurs on the Forest and where additional nesting and roosting would be developed in the future. The management of restrictive areas has had a relatively major, beneficial, indirect effect on local populations of nesting bald eagles, as nesting pairs on and near the Forest in these areas have increased ten-fold since 1992—from one pair to ten. Management would continue to protect these areas and to generally restore forests and/or promote old-growth forest management in riparian habitats. This would indirectly benefit bald eagles by improving nesting, foraging and roosting habitats in both the short and long term. However, the dense canopy-conditions in upland and bottomland forests in restrictively managed areas outside of riparian habitats do not and would not provide favorable nesting or roosting habitats.

The overall, direct and indirect effects of restrictive management on bald eagles have been major, local and beneficial. Wintering populations of bald eagles on the Forest have not increased or decreased to date as a result of Alternative 1. These effects are generally anticipated in the future.

iv. Mead's milkweed

Restrictive management under Alternative 1 (the 1992 Plan) in some natural areas has generally had beneficial effects on local and regional Mead's milkweed plants and populations. However, this natural area management generally has included prescribed fire, selective tree and shrub removal, seed and seedling plantings, as well as forest protection in three research natural areas where the species occurs. When these direct population and indirect habitat disturbances have occurred, individuals and populations of the species on the Forest have benefited. The extent and frequency of prescribed fire and vegetation management actions in these few restrictive-management areas should increase in the future to benefit the species and aid in recovery (USDI, 2003). Overall, restrictive management that includes some localized vegetation management and prescribed fire should continue to have beneficial direct and indirect effects on the species.

v. Least tern, pallid sturgeon, fanshell mussel, fat pocketbook pearly mussel, pink mucket pearly mussel, orange-footed pearly mussel

Restrictive management under Alternative 1 (the 1992 Plan) in all management areas has had no direct or indirect effect on these large river species.

b. Alternatives 2 and 4

Restrictive management under Alternative 2 or 4 would affect approximately 45 percent (127,900 acres) of the Forest. In all of the areas managed restrictively, except for approximately 3,000 to 5,000 acres of natural areas and some of the water-supply watershed and Mississippi and Ohio Rivers floodplains management areas, there would be limited or no timber or other vegetation management activities. Prescribed fire could occur in some parts of all of these management areas.

The majority of these areas would be allowed to succeed towards mature forest and potential old-growth forest conditions. Beech and maple would dominate these old-growth forests in the uplands, with oak and hickory greatly reduced from present numbers. Cypress, cottonwood and oaks would dominate the old growth in the bottomlands. They would have dense canopies and midstories, with minimal herbaceous-understory diversity. Some oak-hickory forests and openlands associated with burning and vegetation management would occur in natural areas, watershed protection areas and the Mississippi and Ohio Rivers floodplains. Maturing forest stands would have more large trees and snags than younger stands. These habitat changes could have indirect effects generally on Indiana bats, gray bats, bald eagles, Mead’s milkweed, least tern, pallid sturgeon, fanshell mussel, fat pocketbook pearly mussel, pink mucket pearly mussel and orange-footed pearly mussel.

i. Indiana bat

The existing and future forest conditions in restrictive-management areas under Alternative 2 would offer some roosting-habitat benefits to Indiana bats in mature and old-growth hardwood forests. However, dense canopies in many of these restrictively managed areas would represent a decline in the quality and quantity of foraging habitats that could offset the benefits to the bats. Also, existing oak-hickory forests in restrictively managed areas that include preferred roosting and foraging habitats would be greatly reduced. The overall benefits for Indiana bats would be the result of minimal and indirect effects on roosting habitat.

ii. Gray bat

Restrictive-management areas are generally where potential foraging habitats exist for gray bats. Management to continue to protect these areas and generally to restore forests and/or promote old-growth forest management in riparian habitats would indirectly benefit gray bats by improving potential foraging habitats in both the short and long term. However, indirect, beneficial effects on individuals and local populations of gray bats have been and would continue to be minor.

iii. Bald eagle

Restrictively managed areas are generally where most bald-eagle nesting and wintering presently occur and where additional nesting and roosting would most likely occur in the future. The management of restrictive areas has had a relatively major, beneficial, indirect effect on local populations of nesting bald eagles. Management would continue to protect these areas and to generally restore forests and/or promote old-growth forest management in riparian habitats. This would indirectly benefit bald eagles by improving nesting, foraging and roosting habitats in both the short and long term. However, the dense canopy conditions in upland and bottomland forests in restrictively managed areas outside of riparian habitats do not and would not provide favorable nesting or roosting habitats.

The overall direct and indirect effects of restrictive management on bald eagles would be large, local and beneficial. Wintering populations of bald eagles on the Forest would most likely not increase or decrease as a result of Alternative 2.

iv. Mead's milkweed

Restrictive management under Alternative 2 would have the same beneficial direct and indirect effects on Mead's milkweed as those described under Alternative 1.

v. Least tern, pallid sturgeon, fanshell mussel, fat pocketbook pearly mussel, pink mucket pearly mussel, orange-footed pearly mussel

Restrictive management, primarily in the Mississippi and Ohio Rivers floodplains management areas, would have indirect and beneficial effects on all these species as managed areas would store sediments and water as farmland is restored to forests and wetlands. Mississippi and Ohio Rivers floodplains management would indirectly result in local reductions in sedimentation of the two rivers, provide for water storage in the floodplain to reduce flood effects and aid in low-flow periods, and contribute floodplain food sources such as fish and invertebrates for river animals. Currently, indirect benefits are minimal and localized because acreage in this management area is small. However, as the acreage increases in the future, these beneficial effects would have a more pronounced, beneficial effect on the riverine threatened and endangered animals.

c. Alternative 3

Restrictive management under Alternative 3 would affect approximately 92 percent of the Forest (262,500 acres). Prescribed fire would be allowed only in some small parts of natural areas; no landscape-level prescribed burns would be accomplished. In all of the restrictively managed areas—except for about 1,000 to 2,000 acres of natural areas—there would be no timber or other vegetation-management activities.

Except for small portions of some natural areas, all management areas would be allowed to succeed to mature-forest and potential old-growth forest conditions and species diversity similar to what is described under Alternative 2 above. These old-growth forests would be dominated by beech and maple in the uplands, with oak and hickory greatly reduced from present numbers. They would have dense canopies and midstories, with minimal herbaceous-understory diversity. Maturing forest stands would have more large trees and snags than younger stands. Only minor amounts of oak-hickory forest and some openlands would occur in natural areas, on the Mississippi and Ohio Rivers floodplains and at the Oakwood Bottoms Greentree Reservoir due to the minimal levels of prescribed fire and reforestation. These habitat changes could have indirect effects generally on Indiana bats, gray bats, bald eagles, Mead's milkweed, least tern, pallid sturgeon, fanshell mussel, fat pocketbook pearly mussel, pink mucket pearly mussel and orange-footed pearly mussel.

i. Indiana bat

The existing and future forest conditions in restrictive-management areas under Alternative 3 have some roosting-habitat benefits for Indiana bats in mature and old-growth hardwood forests. However, dense canopies in many of these restrictively managed areas would represent a decline in the quality and quantity of foraging habitats that could offset the benefits to the bats. Existing oak-hickory forests that include many preferred roosting and foraging habitats would be significantly reduced. The overall effects of restrictive management on Indiana bats would be non-beneficial and indirect.

ii. Gray bat

The effects of restrictive management on the gray bat would be as described under Alternatives 1 and 2.

iii. Bald eagle

The management proposed to protect these areas and to generally restore forests and/or promote old-growth forest management in riparian habitats would indirectly benefit bald eagles by improving nesting, foraging and roosting habitats in both the short and long term. However, the dense-canopy conditions in upland and bottomland forests outside of riparian habitats do not and would not provide favorable nesting or roosting habitats.

The overall effects of restrictive management on bald eagles would be moderately beneficial, local, direct and indirect. Wintering populations of bald eagles on the Forest would most likely not increase or decrease, similar to Alternatives 1 and 2.

iv. Mead's milkweed

Restrictive management would have the same beneficial, direct and indirect effects on Mead's milkweed as those described under Alternatives 1 and 2, except that there would be less landscape-scale, prescribed-burning effects, especially outside of natural areas. The latter would not allow for as great a spread of populations of the milkweed on acreage in the Shawnee Hills. This would not affect recovery objectives; but neither would it allow management for the species beyond basic recovery objectives. Management under Alternatives 1 and 2 would be more beneficial.

v. Least tern, pallid sturgeon, fanshell mussel, fat pocketbook pearly mussel, pink mucket pearly mussel, orange-footed pearly mussel

Restrictive management, primarily in the Mississippi and Ohio Rivers floodplains management areas would have indirect, beneficial effects on all of these species, similar to those described under Alternative 2.

2. Roads and Trails Management

a. Alternative 1

Generally, roads and trails management under Alternative 1 would have no measurable, direct or indirect effects on Indiana and gray bats, bald eagles, Mead's milkweed, least tern, pallid sturgeon, fanshell mussel, fat pocketbook pearly mussel, pink mucket pearly mussel and orange-footed pearly mussel. Road and trail closures would benefit all species by reducing habitat disturbances and, in some instances, rehabilitating habitats. However, they could result in some minimal, direct and indirect, adverse effects on all species except for the gray bat.

i. Indiana bat

Trails and roads maintenance, construction and closure would have minor, direct and indirect effects on Indiana bats in the short term. Hazard-tree removals could have a minimal, adverse, direct effect on Indiana bats if these trees are roost sites and removals are done during roosting periods. Effects would be minor since few trees would be removed annually and many suitable roost trees would remain. Due to the small number of potential roost trees affected, these actions would have a low potential for affecting Indiana bats. If removals were done outside of the roosting season or after surveys, even these minimal, direct, adverse effects would be eliminated.

No new, permanent road construction is planned in any of the management areas. Some temporary roads could be constructed for planned timber harvests. Ninety-five miles (equivalent to approximately 345 acres of road-clearing disturbance) would be reconstructed in the first 15 years. This would affect approximately 0.1% of the Forest. Effects on habitat from this activity would be insignificant due to the small acreage of individual and total projects.

Two trails on closed roads lead to two hibernation sites. Road closures and limited trail use limit disturbances at these sites. Both of these hibernation sites also include internal closures to restrict human disturbance, so few, if any, adverse, indirect effects from management of these trails and old roads are expected.

ii. Gray bat

Road management, including closures, would have no direct or indirect affects on gray bats. Trail management and construction would have no measurable effect on available foraging habitats, since they directly affect few acres and most work would be done when gray bats are not present. They also should have no effect on potential hibernation sites since none are known on the Forest. Forest trails would have no indirect effects on known hibernation sites on private land near the Forest.

iii. Bald eagle

These management activities would not have any direct or indirect effects on wintering or nesting bald eagles, as they would have no effect on existing nest or wintering areas, and any new roads or trails would follow management standards and guidelines for bald eagles and not affect any known sites.

iv. Mead's milkweed

One small, native population and a small experimental population of Mead's milkweed occur adjacent to trails along the rock outcropping in one of the research natural areas. One trail has been water-barred to drain excessive water away from the milkweed location, which had been directly affected by erosion in the past. Hiker-use of this trail continues because of its proximity to one of the geological attractions in the area. Cedar fences have been placed in the area to maintain the location of the trail and help prevent off-trail soil erosion. The population of Mead's milkweed at this site is surviving, but down to ramets, especially in dry years. The trail use at this location, with the mitigation discussed above, has not had a direct, adverse effect on the milkweed.

Other trails within the research natural areas, some of which are old roads, have been closed to equestrian and ATV use, but unauthorized use occurs infrequently in some locations. Law enforcement is required on a regular basis to control this use and its possible effects on Mead's milkweed sites. No sites have been directly affected by unauthorized trail use since closures and enforcement actions have been initiated. Trail-closure, rerouting and enforcement have had, and should continue to have, beneficial, indirect effects on Mead's milkweed.

v. Least tern, pallid sturgeon, fanshell mussel, fat pocketbook pearly mussel, pink mucket pearly mussel, orange-footed pearly mussel

Within the Forest boundary there are approximately 3,300 miles of roads of all management levels (surfaced and unsurfaced), including approximately 500 miles of unsurfaced, or dirt, roads and 600 to 700 miles of trails. Unsurfaced roads and trails contribute some degree of sediment to local watersheds, while surfaced roads add to the runoff volumes of these same watersheds. Management would include repair of drainage structures and surfaces on all roads and trails, and some closures. These actions should prevent or lessen soil erosion and sedimentation, but not totally eliminate it. This sedimentation could have minor, adverse, indirect effects. However, any adverse effects from road and trail management would be insignificant downstream in the two major rivers, adding immeasurably to existing sedimentation that is due primarily to upstream agricultural uses.

b. Alternative 2

Generally, there would be fewer overall effects on all species, especially those associated with the major rivers, since user-developed trails would not be allowed. The reasoning for this is similar to that under Alternative 1.

c. Alternative 3

Effects would be similar to those of Alternative 1 for all species. However, since there would be 250 fewer miles of managed trails, as well as no user-developed trails, there would be slightly less overall effects on all species, especially the aquatic species of the major rivers. The reasoning for this is similar to that under Alternative 1.

d. Alternative 4

Effects would be similar to those of Alternative 1 for all species. However, since there would be fewer miles of managed and user-developed trails, there would be slightly less overall effects on all species, especially the aquatic species of the major rivers. The reasoning for this is similar to that under Alternative 1.

3. Recreational Use of Trails and Roads

a. Alternatives 1 and 4

Road and trail use, including the authorized and unauthorized use of ATVs, under Alternative 1 (the 1992 Plan) has had no measurable, direct or indirect effects on Indiana bats or gray bats. This is expected to continue, as known hibernacula and summer roosting caves have been protected from disturbances that could result from trail use.

Habitats and populations of Mead's milkweed and bald eagles have been threatened by the use under this alternative since 1992, but have not yet been directly or indirectly affected. Bald eagles in southern Illinois appear to be more tolerant of human disturbances. Protective measures to date have been effective in protecting Mead's milkweed from sometimes-high levels of authorized and unauthorized road and trail use, including ATVs, near existing populations. Protective measures identified in Forest-wide standards and guidelines have worked to protect both species from the disturbances associated with trail and road use disturbances.

No measurable effects of road and trail use on least tern, pallid sturgeon, fanshell mussel, fat pocketbook pearly mussel, pink mucket pearly mussel and orange-footed pearly mussel have been identified. Equestrian use of user-developed trails and unauthorized ATV use has resulted in some increased sedimentation in streams near the heaviest use, primarily on the east side of the Forest. This increased sedimentation would have a minimal adverse effect on the downstream aquatic species of the major rivers, since it is unmeasurable in relation to the agricultural sedimentation delivered to these rivers upstream of the Forest, the region and the state.

Based upon past use and effects, no overall adverse or beneficial effects from road and trail use are anticipated for Indiana and gray bats, bald eagle and Mead's milkweed. Minimal levels of adverse, indirect effects in terms of sedimentation on downstream, major-river species are anticipated.

b. Alternative 2

i. Indiana bat and gray bat

Road and trail use throughout the Forest under Alternative 2 would include the restriction of equestrian use to roads and designated trails. Similar to Alternative 1, this alternative would have no measurable, direct or indirect effects on Indiana bats or gray bats.

ii. Bald eagle and Mead's milkweed

Habitats and populations of Mead's milkweed and bald eagles would continue to be unaffected directly or indirectly and would not be threatened by the use of user-developed trails. No measurable overall effects from road and trail use are expected.

iii. Least tern, pallid sturgeon, fanshell mussel, fat pocketbook pearly mussel, pink mucket pearly mussel, orange-footed pearly mussel

Minimal, adverse, indirect effects on these species from increases in sedimentation would be less under this alternative than Alternative 1 because there would be no user-developed trails contributing sediment.

c. Alternative 3

i. Indiana bat and gray bat

Road and trail use under Alternative 3 would cause no measurable, direct or indirect effects on Indiana bats and gray bats, similar to Alternatives 1 and 2.

ii. Bald eagle and Mead's milkweed

Habitats and populations of Mead's milkweed and bald eagles would be affected directly and indirectly. Both would benefit from fewer trails and seasonal closures and subsequently diminished human disturbances. Seasonal closures would benefit bald eagles by limiting human disturbances during the early portions of the annual bald-eagle nesting seasons.

iii. Least tern, pallid sturgeon, fanshell mussel, fat pocketbook pearly mussel, pink mucket pearly mussel, orange-footed pearly mussel

Minimal, adverse, indirect effects from increases in sedimentation would be less under this alternative than Alternatives 1 and 2 because there would be fewer managed trails and no user-developed trails contributing sediment.

4. Dispersed Recreational Use

No measurable effects on any of the threatened and endangered species are anticipated from any dispersed recreational activity under any alternative.

5. Developed Recreational Site Use

No measurable effects on any of the threatened or endangered species are anticipated from the use of any developed recreational site under any alternative.

6. Timber Harvest and Other Vegetation Management

a. Alternative 1

i. Indiana bat

Timber harvest and other vegetation treatments have had relatively no overall direct or indirect effects on Indiana bats to date. Approximately 6,000 acres of hardwood timber harvest—primarily uneven-aged group-selection—and 12,200 acres of pine-timber harvest—primarily shelterwood harvest and thinnings, could be done in the next 15 to 20 years in uneven-aged hardwood forest and mature hardwood forest management areas (Spectrum Model runs, planning record), assuming the maximum timber-harvest level. Direct effects of these actions would be some minor reductions in potential summer roosting-habitats. Harvest in both the summer roosting- and foraging-habitats should have beneficial and indirect effects on the bats by providing higher-quality conditions—more open and more-preferred roosting species, oak-dominated-hardwoods. However, with so few acres of habitat treated (less than ten percent of the Forest), actual effects on local populations would be minimal, and most likely unmeasurable, in the short term.

In the long term (100 years), there would be 234,700 acres of mature-hardwood forest habitat (over 50 years old) for Indiana bats, including 155,400 acres of mature, oak-dominated forest (Spectrum Model runs, planning record). This is 22 percent more than the existing, mature-hardwood forest acreage and 87 percent of the mature oak-dominated, mature-forest acreage. There would be 188,500 acres of old-growth deciduous hardwoods (over 120 years old), including 118,500 acres of old-growth oaks. There currently is no old-growth forest acreage on the Forest (CDS database information, 2oo4).

Compliance with management standards and guidelines would ensure that approximately 2,700 acres of thinnings in natural areas**,** 12,600 acres of timber-stand improvements and 7,900 acres of reforestation of upland and bottomland hardwood forests in the next 15 to 20 years would have no measurable, direct or indirect effects on Indiana bats in the short term. In the long term, increases in mature oak-dominated forests in treated areas of the Forest would improve roosting and foraging habitat. A maximum of approximately 14,000 acres (five percent) of the Forest would be affected by these vegetation treatments and provide beneficial effects for Indiana bats over the next 15 to 20 years. In the long term (100 years), other vegetation treatments would include 34,000 acres of reforestation and 112,000 acres of timber-stand improvement, with associated long-term improvements in mature oak-forest habitat. The overall effect on the Indiana bat—individuals as well as populations and their foraging and roosting habitats—from these activities would be minor, beneficial and indirect.

ii. Gray bat

Timber harvest and other vegetation treatments would have no direct or indirect effects on gray bats, as relatively few acres of these activities are planned in riparian areas or floodplains, historical and potential foraging habitat for the species.

iii. Bald eagle

Timber harvests, thinnings and ecological restorations would not occur in prime nesting or foraging habitats. Some of these activities could be done in uplands and bottomlands in non-restrictively managed areas near prime habitats, which should improve nesting by creating more-open canopy conditions that are favorable to eagle-nesting. The overall effects on the eagle—individuals as well as populations and their foraging and roosting habitats—from these activities would be minor, beneficial and indirect, with over 188,500 acres of old-growth, hardwood forest habitats available for the species Forest-wide in 100 years under Alternative 1.

iv. Mead's milkweed

Timber harvest would have no direct or indirect effects on Mead's milkweed, as none are planned in research natural area locations where the species occurs. Other vegetation treatments have had, and would continue to have, beneficial effects on local and regional populations of the milkweed and aid in its recovery nationally. The opening-up of the grasslands and barrens habitats through these actions would greatly enhance these local habitats and result in substantial, beneficial, direct and indirect effects on Mead's milkweed and be in accordance with the recovery plan (Bowles *et al.*, 2003).

v. Least tern, pallid sturgeon, fanshell mussel, fat pocketbook pearly mussel, pink mucket pearly mussel, orange-footed pearly mussel

Timber harvest could generate small amounts of sediment, although compliance with standards and guidelines would eliminate most sediment resulting from earth-disturbing activities, such as timber harvest, skidding and landing. Only about 900 acres of harvest could occur annually under this alternative in the first 20 years, affecting only 0.3 percent of the Forest. Therefore, the small amounts of sediment that would result from timber harvest would have no measurable, indirect effects downstream in the major river habitats of these species. Other vegetation treatments would have no direct or indirect effects on the major-river species because none are soil-disturbing.

b. Alternative 2

i. Indiana bat

Approximately 11,300 acres of hardwood timber harvest—primarily even-aged shelterwood and shelterwood with reserves—and 12,200 acres of pine-timber harvest—primarily shelterwood harvest and thinnings—could be done in the first 15 to 20 years in even-aged hardwood forest and mature-hardwood forest management areas (Spectrum Model runs, planning record). Direct effects of these actions would be some minor reductions in potential summer roosting habitats. Harvest in both the summer roosting- and foraging-habitats should have beneficial and indirect effects on the bats by providing higher-quality conditions—more open and more-preferred roosting species, oak-dominated-hardwoods. However, with so few acres of habitat treated (less than eight percent of the Forest), actual effects on local populations would be minimal, and most likely unmeasurable, in the short term.

In the long term (100 years), there would be 187,600 acres of mature-hardwood forest habitat (over 50 years old) for Indiana bats, including 120,600 acres of mature, oak-dominated forest (Spectrum Model runs, planning records). This is 98 percent of the existing, mature-hardwood forest acreage and 68 percent of the mature, oak-dominated forest acreage. There would be 130,100 acres of old-growth (over 120 years old), deciduous hardwoods, including 72,400 acres of old-growth oaks. There currently is no old-growth acreage on the Forest (CDS database information, 2oo4).

Approximately 2,700 acres of thinnings in natural areas and 600 acres of hardwood thinnings outside natural areas, 18,000 acres of timber-stand improvements and 13,400 acres of reforestation of upland and bottomland hardwood forests in the first 15 to 20 years would have no measurable, direct or indirect effects on Indiana bats in the short term. An additional 1,700 acres of thinnings in the first 20 years and a total of 8,300 acres in 100 years would be done in stream-bottoms and lower-slope habitats in forest-interior areas. These latter actions would have beneficial, indirect effects on bat habitats within the upland areas by improving the quality of foraging and roosting habitats. In the long term, increases in mature, oak-dominated forests in treated areas of the Forest would improve roosting and foraging habitat. A maximum of about 32,000 acres (11 percent) of the Forest would be affected by these treatments that provide indirect, beneficial effects for Indiana bats over the first 15 to 20 years (Spectrum Model runs, planning record).

In the long term (100 years), other vegetation treatments would include 72,900 acres of reforestation, 204,900 acres of timber-stand improvement and 2,700 acres of thinnings in natural areas, with associated improvements in mature, oak-forest habitat. The overall effect on the Indiana bat—individuals as well as populations and their foraging and roosting habitats—from these activities would be minor, beneficial and indirect.

ii. Gray bat

Timber harvest and other vegetation treatments would have no effects on gray bats, as relatively few acres of these activities are planned in riparian areas or floodplains, the historical and potential foraging habitat for the species.

iii. Bald eagle

Timber harvests, thinnings and ecological restorations would not be done in prime nesting or foraging habitats. Some of these activities could be done in uplands and bottomlands in non-restrictively managed areas near prime habitats. These activities should improve nesting habitats in these locations by creating more-open canopy conditions that are favorable to eagle-nesting. The overall effects on the eagle—individuals as well as populations and their foraging and roosting habitats—from these activities would be minor, beneficial and indirect, with over 130,100 acres of old-growth, hardwood forest habitats available as potential nesting and feeding perches in 100 years under Alternative 2.

iv. Mead's milkweed

Anticipated effects would be the same as those described under Alternative 1.

v. Least tern, pallid sturgeon, fanshell mussel, fat pocketbook pearly mussel, pink mucket pearly mussel, orange-footed pearly mussel

Timber harvest could generate small amounts of sediment, although compliance with standards and guidelines would eliminate most sediment resulting from earth-disturbing activities, such as timber harvest, skidding and landing. About 1,200 acres of harvest could be done annually under this alternative in the first 20 years, annually affecting only 0.4 percent of the Forest. Therefore, the small amounts of sediment that would result from timber harvest would have no measurable, indirect effects downstream in the major river habitats of these species. Other vegetation treatments would have no direct or indirect effects on the major-river species because none are soil-disturbing.

c. Alternative 3

No timber-harvest activities would be allowed, so there would be no related direct or indirect effects on any threatened or endangered species. Other vegetation treatments could include 2,700 acres of tree and shrub removal in natural areas in the first 20 years. This would have minimal, beneficial effects on Indiana bat foraging and roosting habitats, since so few acres of the Forest (0.9 percent) would be affected.

d. Alternative 4

i. Indiana bat

Anticipated effects would be similar to Alternative 2, discussed above, except that only about 10,000 acres of hardwood-timber harvest—primarily even-aged, shelterwood-with-reserves harvest—could be done in the first 15 to 20 years in even-aged hardwood forest and mature-hardwood forest management areas (Spectrum Model runs, planning record). Direct and indirect effects of these actions would be similar to those identified under Alternative 2.

In the long term (100 years), there would be 182,800 acres of mature-hardwood forest habitat (over 50 years old), including 119,600 acres of mature, oak-dominated forest (Spectrum Model runs, planning record). This is 95 percent of the existing, mature-hardwood forest acreage on the Forest and 67 percent of the mature, oak-dominated forest acreage. There would be 128,700 acres of old-growth deciduous hardwoods (over 120 years old), including 74,800 acres of old-growth oaks. There currently is no old-growth acreage on the Forest (CDS database information, 2oo4).

Approximately 2,700 acres of hardwood thinnings, 17,300 acres of timber-stand improvements and 12,900 acres of reforestation of upland and bottomland hardwood forests in the first 15 to 20 years would result in no measurable, direct or indirect effects on Indiana bats in the short term. An additional 1,700 acres of thinnings in the first 20 years, and a total of 8,300 acres in 100 years would be done in stream-bottoms and lower-slope habitats in forest-interior areas. These latter actions would have beneficial, indirect effects on Indiana bat habitats within the upland areas of the forest by improving the quality of foraging and roosting habitats. In the long term, increases in mature, oak-dominated forests in treated areas of the Forest would improve roosting and foraging habitat. A maximum of about 34,600 acres (12 percent) of the Forest would be affected by these treatments and provide indirect, beneficial effects for Indiana bats over the first 15 to 20 years (Spectrum Model runs, planning record).

In the long term (100 years), other vegetation treatments would include 75,000 acres total of reforestation, 240,600 acres of timber-stand improvement, as well as 2,700 acres of thinnings in natural areas, with associated long-term improvements in mature, oak-forest habitat. The overall effect on the Indiana bat—individuals as well as populations and their foraging and roosting habitats—from these activities would be minor beneficial and indirect.

ii. Gray bat

Effects of timber harvest and vegetation treatments on gray bats would be similar to Alternative 2, discussed above.

iii. Bald eagle

Effects of timber harvest and vegetation treatments would be similar to Alternative 2, discussed above, except that there would be slightly less old-growth hardwoods available as nesting and roosting habitats in 100 years.

iv. Mead's milkweed

Effects of timber harvest and vegetation treatments would be the same as those described above under Alternative 1.

v. Least tern, pallid sturgeon, fanshell mussel, fat pocketbook pearly mussel, pink mucket pearly mussel, orange-footed pearly mussel

Effects of timber harvest and vegetation treatments would be similar to Alternative 2, discussed above.

7. Fire Management

a. Alternative 1

i. Indiana bat, gray bat, bald eagle

Fire management, including fire use, has had relatively no effects on Indiana and gray bats and bald eagles and their habitats, since relatively few acres of hardwood forests, especially in riparian areas and floodplains, have been or would be burned annually and totally. Approximately 300 acres per year has been burned on the Forest by wildfires in the ten-year period from 1993 to 2002 and about 600 acres per year has been burned with prescribed fires during the same period.

The same or fewer acres per year of wildfires are expected under Alternative 1 in the future. Approximately 3,600 acres per year (less than 1.2 percent of the Forest) would be burned for brush disposal, hardwood-site preparation, ecological purposes and large-openlands maintenance (Spectrum Model runs, planning record) under Alternative 1 during the first 20 years. Although this would be a six-fold increase in prescribed-burning acreage, only 1.2 percent of the Forest would be affected annually.

No measurable, direct or indirect effects on gray bats, or direct effects on bald eagles would be anticipated in the future from wildfire or fire use under Alternative 1. There would be no direct effects of burning on gray bats, as no known hibernacula occur on the Forest. Burning, whether by wildfire or fire use, would occur so infrequently in riparian forests and on so few acres that no indirect effects on gray bat foraging habitats are expected to occur. Compliance with standards and guidelines for bald eagles would prevent prescribed fire near known nests and winter roosts, so no direct or indirect effects on bald eagles are expected to occur. To date, no wildfires have occurred near bald eagle nest locations and none are anticipated in the future, since riparian nesting-habitats are too damp for fire to adversely affect them during the early nesting and pre-fledgling periods when they are most vulnerable.

Alternative 1 in the long term (100 years) would indirectly affect bald eagles by improving nesting-habitat quality and quantity. Approximately 188,500 acres of old-growth, deciduous hardwood would occur on the Forest, with up to 50,000 acres affected by prescribed fire. That would result in more-open canopies beneficial for roosting and nesting bald eagles. Indirect effects from prescribed fire would be beneficial for bald eagle populations in the long term.

Compliance with Forest-wide standards and guidelines would protect hibernacula and known roosts for Indiana bats from adverse effects of prescribed fire, including smoke in caves or mines during hibernation periods and burning of roost trees during maternity-roosting periods. The latter would not be expected from wildfires, since none have occurred during the growing season. No caves or mines have been affected by smoke from wildfires. With the relative scarcity of wildfires, the possibility of such an occurrence is remote. In the long term, as more hardwood-forest acreage is treated with prescribed fire, the quality of potential roosting-habitats would be improved for Indiana bats and have beneficial, indirect effects on Indiana bat populations on the Forest.

ii. Mead's milkweed

Localized, prescribed fire has had a beneficial effect on Mead's milkweed populations and habitats. Landscape-scale burns over the historical habitats of the species have also been beneficial. Approximately 300 to 500 acres of Mead's milkweed habitat (30 to 40 percent of the species' habitat on the Forest) would be burned, based upon past management plans and the 2003 recovery plan for the species (Bowles *et al*., 2003).

Fire management, primarily prescribed fire, has had, and would continue to have, beneficial effects on local and regional populations of Mead's milkweed and aid in its recovery nationally. The opening-up of the grasslands and barrens habitats for the species through these actions would enhance the local habitats and result in relatively substantial, beneficial, direct and indirect effects on the species.

iii. Least tern, pallid sturgeon, fanshell mussel, fat pocketbook pearly mussel, pink mucket pearly mussel, orange-footed pearly mussel

Wildfire and fire use on the Forest affect so few acres, and cause such minimal soil-loss where and when they burn, that minimal sediment is produced that could affect the downstream major rivers. No direct or indirect effects on the major-river threatened and endangered species are expected under Alternative 1.

b. Alternatives 2 and 4

i. Indiana bat, gray bat, bald eagle

Under these alternatives, the direct and indirect effects of wildfire and fire use would be the same as discussed above for Alternative 1. Approximately 10,100 acres per year (about 3.5 percent of the Forest) would be burned for brush disposal, hardwood-site preparation, ecological purposes and large openlands maintenance (Spectrum Model runs, planning record) in the first 20 years. Although this would be a seventeen-fold increase in prescribed fire acreage, only 3.5 percent of the Forest would be affected annually.

Direct and indirect effects on Indiana bats from wildfire and fire use would be similar to those described for Alternative 1 above, except that indirect effects on habitat quality would be more beneficial for the species, since more acreage of mature-forest habitat would be beneficially affected in both the short and long terms—127,700 acres, or about 44 percent of the Forest.

ii. Mead's milkweed

Effects on Mead's milkweed habitat and populations would be the same as discussed for Alternative 1, above.

iii. Least tern, pallid sturgeon, fanshell mussel, fat pocketbook pearly mussel, pink mucket pearly mussel, orange-footed pearly mussel

Wildfire and fire use on the Forest affect so few acres and cause such minimal soil-loss where and when they burn, that minimal sediment is produced that could affect the downstream major rivers. No direct or indirect effects on the major-river threatened and endangered species are expected from implementation of Alternative 2 or 4.

c. Alternative 3

i. Indiana bat, gray bat, bald eagle

Wildfire and fire use would affect only natural areas and some small areas of Oakwood Bottoms Greentree Reservoir and the Mississippi and Ohio Rivers floodplains, approximately 1,000 acres per year (less than 0.4 percent of the Forest). Effects would be less than those identified for Alternative 1. Effects on all three species would be comparable to the minimal effects of the last ten years. Compliance with Forest-wide standards and guidelines, and the prescribed fire of so few total acres each year, would result in no measurable direct or indirect effects on the foraging, roosting, or nesting habitats of the Indiana bat, gray bat and bald eagle under Alternative 3.

ii. Mead's milkweed

Prescribed fire would have beneficial effects on Mead's milkweed habitat and populations, as described for Alternative 1.

8. Integrated Pest Management

a. Alternative 1

Integrated pest management would have beneficial effects on Mead's milkweed populations by reducing habitat-encroachment and competition from invasive species and, in general, improving habitat-quality for the species. Control could be by a variety of techniques, including the use of herbicides, as is identified in the recovery plan for the species.

Integrated pest-management practices would have no measurable effects on Indiana and gray bats or bald eagles, as none would be applied directly on known, hibernation, roosting and/or nesting habitats of any of the species and only a minimal degree of any activities are anticipated in known or potential foraging habitats of any of the species.

The possible use of aquatic pesticides, such as rotenone, to control invasive fish-species could have direct, adverse effects on some non-target fish and aquatic invertebrates, including freshwater mussels (Heard 1970) in the immediate locations where applied. It is anticipated that few and isolated areas would be treated with these chemicals annually, according to EPA guidelines. Minimal to unmeasurable, adverse, indirect effects would be expected to occur on downstream or non-target–area fish and aquatic invertebrates, including the Least tern, pallid sturgeon, fanshell mussel, fat pocketbook pearly mussel, pink mucket pearly mussel and orange-footed pearly mussel and their habitats.

b. Alternatives 2 and 4

Integrated pest management would have beneficial effects on Mead's milkweed populations similar to those described above for Alternative 1. Integrated pest-management practices would have no measurable effects on Indiana and gray bats, bald eagles, least tern, pallid sturgeon, fanshell mussel, fat pocketbook pearly mussel, pink mucket pearly mussel and orange-footed pearly mussel, similar to Alternative 1, discussed above.

c. Alternative 3

Integrated pest management without the availability of herbicides would be less successful in controlling invasive and competitive species. Subsequently, any beneficial effects on Mead's milkweed populations would be less than under Alternative 2. There would be no direct or indirect effects on Indiana and gray bats, bald eagles, least tern, pallid sturgeon, fanshell mussel, fat pocketbook pearly mussel, pink mucket pearly mussel and orange-footed pearly mussel, since no integrated pest management activities other than the hand-pulling of invasive plants would be allowed.

9. Openings and Openlands Management

a. Alternatives 1 and 4

No direct or indirect effects on any of the threatened and endangered species would occur as a result of openings and openlands management, since none of the species is known to utilize openlands or openings habitats on the Forest, and planned actions in openings and openlands would not affect adjacent or downstream habitats off the Forest.

Mead's milkweed is a species of diverse, native grasslands and barrens. Its current and future habitats on the Forest would be in existing natural areas. According to the species recovery plan, other, less diverse, native grasslands in herbaceous openlands outside of natural areas are not considered suitable habitats.

b. Alternative 2

Openings and openlands management under Alternative 2 would have similar effects to those under Alternative 1 for all species, except Indiana bats. Implementation of Alternative 2 would result in fewer acres affected by openings and openlands management in both the short and long term. Under Alternative 2, approximately 1,700 acres (0.6 percent of the Forest) would be affected annually in the short term. In the long term (100 years), 1,800 fewer acres of wildlife openings would be affected compared to Alternative 1. These unaffected acres would succeed to mature-hardwood forests, becoming foraging and roosting habitat for Indiana bats in the long term. Therefore, the lesser management could have an indirect, beneficial effect on Indiana bats—albeit small, since less than 0.7 percent of the Forest would be involved.

c. Alternative 3

The lack of openings and openlands management under Alternative 3 would affect only the Indiana bat. These effects would be similar to those described above for Alternative 2, except that more acres would succeed to mature hardwoods, approximately 5,200 (two percent of the Forest). The indirect effects on Indiana bats would be more beneficial as a result.

10. Aquatic Resources Management

All Alternatives

i. Mead's milkweed

Aquatic resources management has had, and should continue to have, no effects on Mead's milkweed, a terrestrial species.

ii. Indiana bat, gray bat, bald eagle

Management of the Oakwood Bottoms Greentree Reservoir has had beneficial effects on roosting and foraging habitats of Indiana bats, and a large maternity colony is known from the area. It has not affected gray bats, however, since the area is not a perennial water source and, so, is not suitable foraging habitat for the species. Greentree-reservoir management and maintenance of the oak forests in the area would continue and ensure continuation of the beneficial effects on Indiana bats. Management of the Oakwood Bottoms Greentree Reservoir has had, and should continue to have, beneficial, indirect effects on bald eagle populations and their foraging habitats. Management to maintain fall, winter and early spring waterfowl habitats provides a high-quality food resource for migrating, wintering and early-spring-nesting bald eagles.

Fisheries management in lakes and ponds should have beneficial, indirect effects on bald eagles by maintaining and improving their foraging habitats. Lakes and ponds also provide foraging habitats and water sources for both Indiana and gray bats. Maintenance and improvement of these habitats would have beneficial, indirect effects on all three species. Restoration of streambanks would have some minor, indirect, beneficial effects on foraging habitats for Indiana and gray bats and bald eagles. Improvement of aquatic-habitat conditions for native aquatic invertebrates and fish would have minor, indirect benefits on the Indiana and gray bats and bald eagle.

No effects of lake and pond management on the big-river species are expected since there would be no direct or indirect effects of this management on downstream riverine habitats.

iii. Least tern, pallid sturgeon, fanshell mussel, fat pocketbook pearly mussel, pink mucket pearly mussel, orange-footed pearly mussel

Restoration of streambanks would have some minor, indirect, beneficial effects on major-river habitats for least tern, pallid sturgeon, fanshell mussel, fat pocketbook pearly mussel, pink mucket pearly mussel and orange-footed pearly mussel. Improvement of aquatic-habitat conditions for native aquatic invertebrates and fish would have minor, indirect benefits on the major-river species.

11. Minerals Management

All Alternatives

No minerals management would occur under Alternative 3. Under Alternatives 1, 2 and 4, minerals management, including oil and gas exploration and development, would be at such low levels across the Forest—based on past and current trends—that few total acres would be affected. Operations on these acres would be required to protect and/or avoid threatened or endangered species and their habitats, according to Forest-wide standards and guidelines. As a result, no direct or indirect effects on any of the threatened and endangered species are expected.

Under Alternatives 1, 2 and 4, exploration and/or development of oil, gas, or minerals on the Forest could occur to some extent in all management areas except wilderness. Occasionally, temporary roads would be built associated with exploration and/or development. Removal of trees as part of temporary road construction could occur, but no measurable effects on any of the listed riverine mussels are anticipated, as riparian filter-strip standards and guidelines would eliminate or reduce any adverse effects on known habitats, water quality and potential bat-roosting habitats.

12. Land-Ownership Adjustment

All Alternatives

Land-ownership adjustment has had, and should continue to have, minimal beneficial, indirect effects on each of the threatened and endangered species. No known habitats would be sold or exchanged to any entity or agency not responsible for the protection of the species or their habitat, and habitats for some of the species could be acquired and given protection on the Forest.

CUMULATIVE EFFECTS ON FEDERALLY LISTED THREATENED AND ENDANGERED SPECIES

This discussion of cumulative effects takes into consideration the past, present and reasonably foreseeable future actions specified at the beginning of Chapter 3, principally the actions discussed below. All ten species have been adversely affected by many actions and activities throughout their native ranges. These have contributed cumulatively to the conditions that led to their current status.

Within the Forest boundary, non-public lands make up about 65 percent of the land-base. Land-use activities on these private properties are determined by the landowner. Some land-use practices on these properties might benefit the listed species, some might have no effect, and some might be detrimental. What happens on these lands can also affect these species and their habitat on the Forest.

The Forest Service will continue to cooperate with other agencies, individuals and organizations to take actions in furtherance of meeting responsibilities under the Endangered Species Act to conserve listed species. The Forest is located in an altered and fragmented landscape in southern Illinois. Alterations have included the clearing of hardwood forests for farm and pastureland and for housing and associated human developments. All of the hardwood forests in southern Illinois in the past have been subjected to some type of timber harvest and, in many cases, grazed by farm animals. Burning in these hardwood forests was a common practice prior to the 1930's. Prescribed fire in pine plantations and openlands on the Forest and in some hardwood areas has been done in the last 20 years. Some eroded farmlands and oldfields on the Forest have been reclaimed and planted in non-native pine and native hardwoods since the early 1940's. Trends in forests on private lands in Illinois, including near the Forest, are to more mature forests with much less oak-dominance (Schmidt *et al.*, 1998).

Much of the watersheds of the rivers and lakes frequented by Indiana and gray bats and bald eagles is in private or other ownerships. Land-use activities that occur on other ownerships can also affect water quality in rivers and lakes that pass through or are adjacent to national forest lands. Large floods of the Mississippi River in 1993 and 1995 affected both protected and unprotected floodplain habitats of the river, including areas on the Forest. Increased mortality of mature, bottomland-hardwood trees both on and off the Forest has resulted from these floods.

Currently, large snags and den trees associated with mature, hardwood forests are common on the Forest (Haugen, 2003). Mature hardwood forests (over 50 years old) comprise approximately 184,700 acres, about 65 percent of the Forest. The Forest Plan specifies that, at most, 13 percent (approximately 25,000 acres) of this would be scheduled for timber management in the next 15 years. Additionally, prescribed fire would be done on approximately 14,000 acres over the next 15 years, with about 70 percent of this occurring in mature, hardwood forests.

Much of the Union and Alexander County areas with silica mineral deposits have been deep-mined in the past and with strip mines more recently. Much of the surface area in these once-mined locations is now part of the Forest. Most of the caves in southern Illinois have had some human disturbances in the past, including trash-dumping and frequent visitation. Some quarrying has occurred on private land in or adjacent to hibernacula and/or summer roosting caves for both Indiana and gray bats. Some trespass into abandoned mines has occurred and continues to occur, especially in those with easily accessible entrances. Caves and mines with known Indiana bat populations on the Forest have been managed to improve habitat conditions through protective gating and entrance-stabilizations. Past and recent land acquisitions for the Forest have included caves with bat populations. Future actions are expected to be similar to past and present actions.

All Alternatives

a. Indiana bat

Overall, planned timber harvest and its associated vegetation management, and prescribed fire in summer roosting and foraging habitats would affect few acres in the Forest vicinity. This management, combined with restrictive management actions, would result in more acreage of mature hardwoods in both the short and long term and more old-growth hardwoods in the long term, providing more habitat quality and quantity than what exists today. Management of aquatic resources, including the Oakwood Bottoms Greentree Reservoir, would continue to have beneficial indirect effects on both roosting and foraging habitats in both the short and long term. Proactive management of caves and mines with known Indiana bat populations would continue to have beneficial effects on the bat populations.

Considered together with the effects of past, present and reasonably foreseeable future actions on and around the Forest, the implementation of any of the alternatives would result in cumulative, beneficial effects, with populations expected to show small-to-moderate increases in both summer and winter on the Forest and in the vicinity. However, high-quality summer and winter habitat is required on land under other ownerships in order to help populations stabilize and eventually increase substantially in southern Illinois and throughout their range. Table 3-22a presents the effects-indicators for the Indiana bat.

b. Gray bat

Alternative 1 would have minor, beneficial, indirect effects on local populations of gray bats, due to improvements in their foraging habitats from restrictive area management, aquatic resource management and land-ownership adjustment. Other management activities on the Forest should have no effects on gray bats. However, overall, land-use decisions made by other owners affect gray bat populations more than activities carried out on the Forest. The only known hibernacula and summer roosting-cave for the species is on private land and subjected to ongoing quarrying actions. It is monitored by the IDNR.

Considered together with the effects of past, present and reasonably foreseeable future actions on and around the Forest, the implementation of any of the alternatives would result cumulatively in minimal to unmeasurable effects on potential summer roosting and winter hibernacula and potential foraging habitat and, subsequently, on local and regional gray bat populations. Table 3-22b presents the effects-indicators for the gray bat.

c. Bald eagle

Considering the effects of past, present and reasonably foreseeable future actions on the bald eagle and its habitats, both on and off the Forest, the implementation of any of the alternatives would result in cumulative, beneficial effects on local populations of bald eagles from improvements in foraging and nesting habitats on the Forest. Local nesting populations are expected to continue to increase until available nesting habitat on the Forest is occupied. Wintering populations are expected to increase as the regional populations of eagles increase, but are as dependent upon local weather conditions as they are on Forest management. Table 3-22c presents the effects-indicators for the bald eagle.

Table 3-22a. Effects-indicators for the Indiana bat (species and habitat).

Current condition of population:
Suitable ecological conditions either broadly distributed or of high abundance across historical range of the species, but gaps exist where suitable ecological conditions are absent or in low abundance. Populations are contiguous on Forest and throughout range, but lower than historically.

Current condition of habitat:
Mature-hardwood forest acreage: 191,900; old-growth hardwood acreage: 0; mature-oak–dominated hardwood acreage: 177,800; managed hibernacula: 6 on Forest, 4 on private lands monitored within boundary; managed maternity colonies: 3 known

Alternative 1 Effects on species	Alternative 1 Effects on habitat indicators (in decades 2 and 10)	Alternatives 2 and 4 Effects on species	Alternatives 2 and 4 Effects on habitat indicators (in decades 2 and 10)	Alternative 3 Effects on species	Alternative 3 Effects on habitat indicators (in decades 2 and 10)
Maintain or improve summer and winter populations on Forest in upland and bottomland forests and within the central hardwood range of the species.	Mature hardwood forest acreage: 200,200 and 234,700. Old-growth hard-wood acreage: 0 and 188,500. Mature-oak–dominated hardwood acreage: 169,600 and 155,400. Managed hibernacula: 6 on Forest, 4 on private lands. Managed maternity colonies: 3 known.	Maintain or improve summer and winter populations on the Forest in upland and bottomland forests and within the central hardwood range of the species.	Mature hardwood forest acreage: 200,100-200,900 and 182,800-187,600. Old-growth hardwood acreage: 0 and 128,700-130,100. Mature-oak –dominated hard-wood acreage: 172,300 and 119,600-120,000. Managed hibernacula: 6 on Forest, 4 on private lands. Managed maternity colonies: 3 known	Maintain or improve summer and winter populations on the Forest in upland and bottomland forests and within the central hardwood range of the species.	Mature hardwood forest acreage: 200,600 and 261,100. Old-growth hard-wood acreage: 0 and 223,900. Mature oak-dominated hardwood acreage: 171,400 and 134,000. Managed hibernacula: 6 on Forest, 4 on private lands. Managed maternity colonies: 3 known.

Table 3-22b. Effects-indicators for the gray bat (species and habitat).

<u>Current condition of population</u>: Suitable ecological conditions are either broadly distributed or of high abundance across the historical range of the species, but there are gaps where suitable ecological conditions are absent or in low abundance. Populations are rare on the Forest, as they have been historically, but they are increasing throughout the range.
<u>Current condition of habitat</u>: Managed riparian forest acreage (from CDS information): 9,100; managed perennial rivers and streams: 150 miles; managed reservoir acreage on the Forest: 7,500 acres; hibernacula and summer maternity-roost: 1 within Forest boundary on private land monitored by IDNR.
<u>All effects on species and habitat indicators under any alternative</u>: Same as the current condition.

Table 3-22c. Effects-indicators for the bald eagle (species and habitat).

<u>Current condition of population</u>:
Suitable ecological conditions either broadly distributed or of high abundance across the historical range of the species, but there are gaps where suitable ecological conditions are absent or in low abundance. Populations contiguous on Forest and throughout the range, but lower than historically.

<u>Current condition of habitat</u>:
Managed nesting and winter roost-habitats on the Forest: 12,700 acres of filter strips adjacent to perennial water bodies; 10,500 acres of riparian and wetland management areas (FR, OB); 1,100-2,000 acres of managed swamp habitats

<u>Alternative 1</u> Effects on species	**<u>Alternative 1</u>** Effects on habitat indicators (in decades 2 and 10)	**<u>Alternatives 2 and 4</u>** Effects on species	**<u>Alternatives 2 and 4</u>** Effects on habitat indicators (in decades 2 and 10)	**<u>Alternative 3</u>** Effects on species	**<u>Alternative 3</u>** Effects on habitat indicators (in decades 2 and 10)
Increasing nesting-population trends, with 5 known nesting territories and nests on the Forest. Increasing wintering populations.	Managed nesting and winter roost-habitats on the Forest: 12,700 acres of filter strips on perennial water bodies; 10,500 acres of riparian and wetland management areas (FR, OB); 1,100-2,000 acres of managed swamp habitats.	Same as under Alternative 1.	Managed nesting and winter roost habitats on the Forest: 12,700 acres of filter strips on perennial water bodies; 30,700 acres of riparian and wetland management areas (FR, OB); 1,100-2,000 acres of managed swamp habitats.	Same as under Alternative 1.	Same as under Alternatives 2 and 4.

d. Mead's milkweed

Considering the effects of past, present and reasonably foreseeable future actions on local populations of Mead's milkweed, both on and off the Forest, the implementation of any of the alternatives would result in cumulative, beneficial effects on local populations of the milkweed. Management actions under all alternatives would be consistent with the Mead's milkweed recovery plan (USFWS, 2003) and would aid in the species' recovery throughout its range. Table 3-22d presents the effects-indicators for the Mead's milkweed.

Table 3-22d. Effects-indicators for Mead's milkweed (species and habitat).

Current condition of population: Suitable ecological conditions isolated and in very low abundance on Forest and throughout the range. Populations on Forest isolated from all other known populations throughout the range and not considered self-sustaining without continued habitat management. Species range on Forest similar to historical range, but much reduced elsewhere throughout the range.
Current condition of habitat: Acreage of managed barrens habitats on the Forest with known populations: 900; acreage of barrens habitats on Forest with experimental populations: 200.
All effects on species and habitat indicators under any alternative: One growing and self-sustaining native population and one self-sustaining experimental population, in accordance with the recovery plan.

e. Least tern, pallid sturgeon, fanshell mussel, fat pocketbook pearly mussel, pink mucket pearly mussel, orange-footed pearly mussel

Considering the effects of past, present and reasonably foreseeable future actions on the major-river threatened and endangered species, both on and off the Forest, the implementation of any of the alternatives would result in no measurable, cumulative effects on local and regional populations of these species because their major-river habitats are mainly affected by the water quality and river-alteration effects of upstream, private, land-management activities in large agriculture-dominated watersheds. Table 3-22e presents the effects-indicators for the least tern, Table 3-22f for the pallid sturgeon, and Table 3-22g for the riverine mussels.

Table 3-22e. Effects-indicators for the least tern (species and habitat).

Current condition of population: Suitable ecological conditions isolated and at very low abundance in major rivers near Forest and throughout the range. Species does not occur on Forest, but in very low populations nearby and/or downstream.
Current condition of habitat: No suitable nesting habitat on Forest. Some potential foraging habitat on Big Muddy River and wetlands within Mississippi River floodplain.
All effects on species under any alternative: Same as historically on the Forest and throughout the range.
All effects on habitat indicators under any alternative: Same as historically on the Forest.

Table 3-22f. Effects-indicators for the pallid sturgeon (species and habitat).

Current condition of population: Suitable ecological conditions isolated and at very low abundance in major rivers adjacent to the Forest and throughout the range. Species does not occur on the Forest, but does occur in very low populations nearby and downstream.
Current condition of habitat: No suitable habitat on the Forest. Management of streams and watersheds that are tributaries of the Mississippi River can affect habitats for the species immediately downstream.
All effects on species under any alternative: Same as historically on the Forest and throughout the range.
All effects on habitat indicators under any alternative: Managed acreage of filter strips and floodplains on the Forest with beneficial indirect effects on the Mississippi River: about 19,000 (including about 8,000 acres in MO management area under Alternatives 2, 3 and 4).

Table 3-22g. Effects-indicators for the riverine mussels: fanshell, fat pocketbook pearly, pink mucket pearly and orange-footed pearly (species and habitat).

Current condition of population:
Suitable ecological conditions isolated and at very low abundance in major rivers near Forest and throughout the range. Species does not occur on Forest, but does occur in very low populations nearby and/or downstream.

Current condition of habitat:
No suitable habitat on the Forest. Management of streams and watersheds that are tributaries of the Mississippi River can affect habitats immediately downstream of the Forest.

Alternative 1 Effects on species	**Alternative 1** Effects on habitat indicators (in decades 2 and 10)	**Alternatives 2 and 4** Effects on species	**Alternatives 2 and 4** Effects on habitat indicators (in decades 2 and 10)	**Alternative 3** Effects on species	**Alternative 3** Effects on habitat indicators (in decades 2 and 10)
Same as historically on the Forest and throughout the range.	Managed acreage of wetlands, flood-plains and filter strips with beneficial, indirect effects on both the Mississippi and Ohio Rivers: about 53,500 (including 5,800 in management area FR).	Same as historically on the Forest and throughout the range.	Managed acreage of wetlands, flood-plains and filter strips with beneficial, indirect effects on both the Mississippi and Ohio Rivers: about 53,500 (including 8,600 in MO management area).	Same as historically on the Forest and throughout the range.	Managed acreage of wetlands, flood-plains and filter strips with beneficial, indirect effects on both the Mississippi and Ohio Rivers: about 53,500 (including 8,600 in MO management area).

4. REGIONAL FORESTER SENSITIVE SPECIES (RFSS)

a. Wildlife and Fish

The current conditions and a detailed discussion of the effects of the alternatives on the current RFSS are addressed in a biological evaluation that is part of the planning record. The RFSS wildlife and fish are displayed in Table 3-23.

Table 3-23. RFSS wildlife and fish.

Mammals	
Eastern woodrat (*Neotoma floridana*)	Southeastern *myotis* (*Myotis austroriparius*)
Birds	
Cerulean warbler (*Dendroica cerulea*)	Swainson's warbler (*Limnothlypis swainsonii*)
Migrant loggerhead shrike (*Lanius ludvicianus migrans*)	Henslow's sparrow (*Ammodramus henslowii*)
Fish	
Bantam sunfish (*Lepomis symmetricus*)	Bluehead shiner (*Pteronotropis hubbsi*)
Reptiles/amphibians	
Northern copperbelly watersnake (*Nerodia erythrogaster neglecta*)	Timber rattlesnake (*Crotalus horridus*)
Bird-voiced treefrog (*Hyla avivoca*)	
Invertebrates	
Indiana crayfish (*Orconectes indianensis*)	Kentucky crayfish (*Orconectes kentuckiensis*)
Bigclaw crayfish (*Orconectes placidus*)	Subtle cave amphipod (*Stygobromus subtilis*)
Carinate pillsnail (*Stenotrema hubrichti*)	

i. RFSS of swamp habitats

(bird-voiced treefrog, bantam sunfish and bluehead shiner)

The bird-voiced treefrog, bantam sunfish and bluehead shiner are, or were, species of swamp habitats on and near the Forest. Currently, the bluehead shiner is considered extirpated from Illinois (Ranvestel and Burr, 2002).

ii. RFSS of stream habitats

(Indiana crayfish, Kentucky crayfish, bigclaw crayfish)

Indiana crayfish, Kentucky crayfish and bigclaw crayfish are species of stream habitats on and near the Forest. Sections of some of the perennial streams on the Forest are habitats for the crayfish species (Taylor, 2002). The Indiana crayfish is restricted to sections of perennial streams in the Saline River watershed, with most populations isolated from each other by past habitat alternations mostly associated with coal mining (Taylor, 2002). The Kentucky and bigclaw crayfish are found exclusively in Big Creek and its tributaries (Taylor, 2002). Water quality and stream habitats in Big Creek are generally considered good and the stream is a candidate wild and scenic river study area.

iii. RFSS of openlands habitats

(Henslow's sparrow, migrant loggerhead shrike)

Henslow's sparrow and the migrant loggerhead shrike are species of openland habitats in southern Illinois and a few locations on the Forest. Henslow's sparrow is a species of large-grassland habitats in Illinois (Herkert, 1994 and Burhans, 2001). The migrant loggerhead shrike is a species of oldfields, brushlands and fencerows (Barbour and Mohr, 2002). Both species are rare residents on the Forest in large oldfields and grasslands primarily on the east side.

iv. RFSS of mature-bottomland and floodplain-forest habitats

(cerulean warbler, Swainson's warbler)

The cerulean warbler and Swainson's warbler are Neotropical migrants: summer residents of mature bottomland and floodplain forests and winter residents of Central or South America. The cerulean warbler also utilizes upland hardwood-forests throughout much of its range, including the Forest, but is most abundant in large blocks of mature floodplain or bottomland forests.

Both species occur or, as in the case of Swainson's warbler, historically occurred, in the Cave Valley (CV) management area, with the cerulean warbler extremely abundant (Vanderah, 1993). It is the more abundant and widespread of the two species on the Forest. It is known from nine counties in southern Illinois and from Cedar Creek, Little Grand Canyon-Horseshoe Bluff and LaRue-Pine Hills/Otter Pond ecological areas on the west side of the Forest. It is much less common on the east side. Swainson's warbler is known historically from only the Cave Valley area on the Forest as well as from six counties in southern Illinois, including state and federal lands along the Cache River south of the Forest. The Swainson's warbler nests in shrubby or low, dense understory vegetation, including cane in mature floodplain-forests, while the cerulean warbler is a canopy-nesting species in mature or old-growth hardwood trees.

In the mid-1980's, the Forest attempted to improve habitat for Swainson's warbler in the Cave Valley area, when the species' population had declined to one pair. Management was based on information provided by Eddleman *et al.* (1980) in a study of the habitat needs of the species in Cave Valley, and consisted of small clearcuts less than four hectares in size. Neither giant cane nor Swainson's warbler responded to this management. It has not been determined whether the Forest's actions caused the extirpation of the species in this area, or if extirpation was inevitable due to the fact that the population of two birds was already too small to be able to respond to any habitat improvements. Current research on the species indicates that forest management, including selective thinnings and small clearcuts in riparian forests, is still a suggested practice for management of the species (Graves, 2002 and Eddleman, 2005).

v. RFSS of scrub-shrub wetland habitats

(northern copperbelly watersnake)

In Illinois, the northern copperbelly watersnake occurs throughout the southeastern area of the state (Smith, 1961) and intergradates broadly with the yellowbelly variant in central-southern Illinois (Smith, 1961; Brandon and Blanford, 1994). The two subspecies appear to be genetically contiguous in this area. Distribution of the species on the Forest is limited to the east side. At the landscape level, large patches of scrub-shrub wetlands with saturated soils within a matrix of intermittently flooded, palustrine-forest habitat are prime copperbelly habitat.

vi. RFSS of dry, upland-forest habitats

(timber rattlesnake, eastern woodrat)

Both species are associated with dry upland forests, oak-hickory forests, and rock outcroppings and bluffs of southern Illinois and the Forest. Timber rattlesnakes also utilize riparian and floodplain forests, especially on the west side of the Forest. Known populations of woodrats in Illinois are found almost exclusively on the west side of the Forest. The IDNR and the Forest are working currently to reestablish woodrat populations on the east side of the Forest, associated with large rock-outcroppings and bluffs in historical habitats. Timber rattlesnakes are known from nine area counties—Alexander, Gallatin, Hardin, Jackson, Johnson, Pope, Saline, Union and Williamson. They are found extensively on the west side of the Forest. Scattered populations are found on the east side of the Forest in Saline, Pope, Gallatin and Hardin Counties.

vii. RFSS of seep, spring, cave habitats

(subtle cave amphipod)

This is a species of seeps, springs, caves, and epikarstic groundwater (Lewis, 2003) that occurs in southern Illinois, including one location on the west side of the Forest (Lewis, 2003 and Peck and Lewis, 1978). The other known locations in southern Illinois are in state parks and generally protected from habitat disturbances. The location within the Forest boundary is Toothless Cave, jointly owned by private individuals and the Forest, with private individuals controlling the entrance. In cooperation with the landowner, IDNR has installed a gate to prevent recreational access. The watershed, or habitat, of the cave is heavily forested, mostly in Forest ownership, and managed as a natural area to protect the ecological conditions/habitat.

viii. RFSS of cave and forested-wetland habitats

(southeastern myotis)

This species occupies caves, mines and mature, forested wetlands. Summer roosts are usually in hollow bottomland-forest trees near water, but can also be in caves and mines. The bats forage over water in floodplain, riparian-hardwood and upland, oak-hickory forests. Winter hibernacula are generally caves. In Illinois, the species is known from five area counties—Alexander, Hardin, Johnson, Pope and Union—and, in southern Illinois, is at the northern extent of its range. Two maternity colonies of the species have been documented in southern Illinois (Hoffman *et al*., 1999) and one winter hibernacula for the species has been identified in a cave on the Forest. Recreational use and associated human disturbances at this cave have been controlled by a gate that prevents access.

Known roosting and foraging habitat includes, but is not limited to, Little Grand Canyon-Horseshoe Bluff, LaRue-Pine Hills/Otter Pond and Grantsburg Swamp (Bell Pond) ecological areas and vicinities (Gardner, 1992). The species has been identified as declining in Illinois (Gardner, 1992).

ix. RFSS of limestone-cliff habitats

(carinate pillsnail)

This is a species restricted to the limestone bluffs and cliffs of LaRue-Pine Hills/Otter Pond research natural area.

b. Plants

The current conditions and a detailed discussion of the effects of the proposed alternatives on the current RFSS list of plants are addressed in a biological evaluation that is part of the planning record. The RFSS plants are displayed in Table 3-24.

Table 3-24. RFSS plants.

Amorpha nitens (shining false-indigo)	*Juglans cinerea* (butternut)
Asplenium bradleyi (Bradley's spleenwort)	*Lilium superbum* (Turk's-cap lily)
Asplenium resiliens (black-stem spleenwort)	*Lonicera dioica* var. *glaucescens* (limber honeysuckle)
Bartonia paniculata (twining screwstem)	*Lonicera flava* (yellow honeysuckle)
Berberis canadensis (American barberry)	*Lysimachia fraseri* (Fraser's yellow loosestrife)
Buchnera americana (American bluehearts)	*Oxalis illinoensis* (Illinois wood-sorrel)
Calamagrostis porteri ssp. *insperata* (Porter's reedgrass)	*Panax quinquefolius* (American ginseng)
Carex communis (fibrous-root sedge)	*Phaeophyscia leana* (wreath lichen)
Carex decomposita (cypress-knee sedge)	*Plantago cordata* (heartleaf plantain)
Carex gigantea (giant sedge)	*Platanthera clavellata* (small green wood-orchid)
Carex lupuliformis (false-hop sedge)	*Platanthera flava* var. *flava for p* (pale green orchid)
Carex oxylepis var. *pubescens* (sharp-scaled sedge)	*Poa alsodes* (grove bluegrass)
Carex socialis (low woodland sedge)	*Polygala incarnata* (procession flower)
Chamaelirium luteum (fairywand)	*Pycnanthemum albescens* (whiteleaf mountainmint)
Chelone obliqua var. *speciosa* (red turtlehead)	*Pycnanthemum torrei* (Torrey's mountainmint)
Cimicifuga rubifolia (Appalachian bugbane)	*Rhynchospora glomerata* (clustered beak-sedge)
Cladrastis kentukea (Kentucky yellowwood)	*Rudbeckia fulgida* var. *sullivantii* (Sullivant's coneflower)
Corydalis micrantha ssp. *australis* (smallflower fumewort)	*Sagittaria australis* (longbeak arrowhead)
Cypripedium pubescens (greater yellow lady's-slipper)	*Schoenoplectrus purshianus* (weakstalk bulrush)
Dichanthelium joorii (variable panic-grass)	*Silene ovata* (Blue Ridge catchfly)
Dichanthelium ravenelii (Ravenel's rosette-grass)	*Silphium pinnatifidum* (tansy rosinweed)
Dichanthelium yadkinense (Yadkin's panic-grass)	*Silphium trifoliatum* (whorled rosinweed)
Dodecatheon frenchii (French's shooting-star)	*Stenanthium gramineum* (eastern featherbells)
Echinacea simulata (wavyleaf purple-coneflower)	*Styrax grandifolius* (bigleaf snowbell)
Eleocharis wolfii (Wolf's spikerush)	*Synandra kispidula* (Guyandotte beauty)
Festuca paradoxa (clustered fescue)	*Thelypteris noveboracensis* (New York fern)
Gentiana alba (plain gentian)	*Trichomanes boschianum* (Appalachian bristle-fern)
Helianthus silphioides (rosinweed sunflower)	*Trifolium reflexum* (buffalo clover)
Heteranthera reniformis (kidneyleaf mudplantain)	*Vaccinium stamineum* (deerberry)
Hexalectris spicata (spiked-crested coralroot orchid)	*Vitis rupestris* (sand grape)
Hottonia inflata (American featherfoil)	*Waldensteinia fragarioides* (Appalachian barren strawberry)
Isotria verticillata (purple fiveleaf orchid)	

i. RFSS of barrens habitats

(*Buchnera americana, Corydalis micrantha* ssp. *australis, Echinacea simulata, Festuca paradoxa, Gentiana alba, Helianthus silphiodes, Hexalectris spicata, Polygala incarnata, Pycnanthemum torrei, Silphium pinnatifidum, Silphium trifoliatum*)

These are sensitive plants of barrens habitats.

ii. RFSS of upland and oak-hickory forest habitats

(*Calamagrostis porteri* ssp. *insperata, Carex communis, Cypripedium pubescens, Dichanthelium ravenelii, Pycnanthemum albescens, Trifolium reflexum, Vaccinium stamineum*)

These are sensitive plants of dry, upland-forests, upland oak-woodland and oak-hickory forest habitats.

iii. RFSS of dry-mesic and mesic hardwood-forest habitats

(*Carex oxylepis* var. *pubescens, Carex socialis, Chamaelirium luteum, Cimicifuga rubifolia, Cladrastis kentukea, Lilium superbum, Oxalis illinoensis, Panax quinquefolius, Poa alsodes, Silene ovata, Styrax grandifolius, Synandra hispidula*)

These are sensitive plants of dry-mesic and mesic hardwood-forest habitats.

iv. RFSS of wetlands habitats

(*Amorpha nitens, Carex decomposita, Carex gigantea, Carex lupuliformis, Chelone obliqua* var. *speciosa, Dichanthelium joorii, Dichanthelium yadkinense, Eleocharis wolfii, Heteranthera reniformis, Hottonia inflata, Juglans cinerea, Lysimachia fraseri, Phaeophyscia leana, Plantago cordata, Platanthera flava* var. *flava, Rhynchospora glomerata, Schoenoplectus purshianaus, Stenanthium gramineum, Vitis rupestris*)

These are sensitive plants of riparian and floodplain forests, swamps and wetland habitats.

v. RFSS of cliff habitats

(*Asplenium bradleyi, Asplenium resiliens, Berberis canadensis, Dodecatheon frenchii, Lonicera dioica* var. *glaucescens, Lonicera flava, Trichomanes boschianum, Waldsteinia fragarioides*)

These are sensitive plants of cliff habitats.

vi. RFSS of spring and seep habitats

(*Bartonia paniculata, Isotria verticillata, Platanthera clavellata, Rudbeckia fulgida* var. *sullivantii, Sagittaria australis, Thelypteris noveboracensis*)

These are sensitive plants of spring and seep habitats.

DIRECT AND INDIRECT EFFECTS ON RFSS

Detailed life-history and habitat-use information and descriptions of effects on each RFSS are found in the biological evaluations prepared for this analysis (planning record). The following are summaries of the biological evaluation information. Species are grouped by habitat and management needs as they generally respond in a similar manner to each alternative.

1. Wildlife and Fish

a. RFSS of swamp habitats

(bird-voiced tree frog, bantam sunfish, bluehead shiner)

Under all alternatives, roads and trails management and use, developed recreational site use, dispersed recreational use, timber harvest, integrated pest management, openings and openlands management and minerals management are expected to have no direct or indirect effect on the species since none of these activities would directly or indirectly affect swamp habitats. Restrictive management, vegetation treatments, aquatic resource management and land-ownership adjustment would have beneficial, direct and indirect effects on these species in both the short and long terms, primarily through management to protect the water quality and hydrology of the swamp habitats. Fire management (primarily prescribed fire) could have minimal, direct effects in the short term in terrestrial habitats adjacent to swamps, where isolated, individual bird-voiced treefrogs might occur in both spring and fall. However, it is not likely to cause any loss of populations or affect population viability for the species since very few individuals would be affected.

Integrated pest management, primarily the chemical control of predatory, competitive, or invasive species would have beneficial effects on both fish species under Alternatives 1, 2 and 4, all of which allow its use. It could have adverse effects on both species under Alternative 3, which does not allow its use. The lack of this management tool under Alternative 3 could hinder reintroduction efforts for the bluehead shiner, as well as any restablishment efforts for bantam sunfish.

b. RFSS of stream habitats

(Indiana crayfish, Kentucky crayfish, bigclaw crayfish)

Under all alternatives, dispersed recreational use, developed recreational site use, timber harvest, vegetation treatments, fire management, openings and openlands and minerals management would have no direct or indirect effects on any of the crayfish species. Compliance with standards and guidelines for timber harvest and mineral exploration or development would protect water quality by minimizing soil-disturbing actions. No measurable, direct effects on water quality and stream habitats for the species are expected from any of these activities.

Under all alternatives, restrictive management in the NA, CR and WD management areas and associated with riparian filter-strip and floodplain standards and guidelines would have a beneficial, indirect effect on all three species, since habitats for all would improve with the management direction to protect both water quality and stream habitats in these areas.

Land-ownership adjustment in the habitats of the three species would be beneficial, since protection and/or improvement of habitats would occur under Forest ownership and management. Aquatic resource management, primarily associated with stream-habitat improvements, would result in beneficial, indirect effects on all three species.

Roads and trails management and use under Alternatives 1 and 4, including user-developed trails and authorized and unauthorized ATV use, would result in indirect, adverse effects on all three species from associated, adverse effects on water quality. Roads and trails management and use under Alternatives 2 and 3 would result in overall, beneficial, indirect effects on the crayfish, since authorized use would be on designated and managed trails only, and user-developed trails would be eliminated and/or rehabilitated. Unauthorized ATV use is expected to continue to occur to some extent, but is not expected to have measurable effects on habitats of the three species.

Under Alternatives 1, 2 and 4, integrated pest management that allows the chemical control of non-native invasive fish and crayfish species would have a beneficial, indirect effect on the species. Conversely, the chemical control of non-native, invasive species in the crayfish habitats would not be allowed under Alternative 3 and, so, the viability of all three species could be adversely affected.

c. RFSS of openlands habitats

(Henslow’s sparrow, migrant loggerhead shrike)

Under all alternatives, roads and trails management, recreational use of trails and roads, dispersed recreational site use, developed recreational use, developed recreational site use, timber harvest, aquatic resource management and minerals management are expected to have no effects on either of these openland species. Under all alternatives, land-ownership adjustment could be beneficial for both species in both the short and long term whenever large, agricultural fields, pastures, and oldfields are acquired by the Forest and subsequently managed to maintain grasslands and oldfield habitats. Activities at the Dixon Springs Agricultural Center are expected to have beneficial, indirect effects on both species in the short term, in locations and years when large, grazed pastures are idled by station management.

Habitats for both species would be adversely affected in the short term by management actions under Alternatives 1, 2 and 4 to keep oldfields and grasslands from succeeding to hardwoods. These actions include fire management, vegetation treatments, integrated pest management and openings and openland management. These same actions would have beneficial effects on both species in the long term, as grasslands and oldfields habitats are managed for both species. Proposed management actions under Alternative 3 do not include vegetation management in openland habitats and, so, would have adverse effects on both species in both the short and long terms.

d. RFSS of mature-bottomland and floodplain-forest habitats

(cerulean warbler, Swainson’s warbler)

Under any alternative, developed recreational site management, integrated pest management, aquatic resource management and minerals management are expected to have no effects on either species, because these activities would not occur in their habitats or, if they did, would not affect individuals and/or habitats of either species. Land-ownership adjustment would be beneficial for both species in both the short and long terms, especially when floodplain habitats are acquired and subsequently managed to maintain mature forests. Restrictive management, especially in the CR, CV, NA, WD and FR management areas, and riparian and floodplain filter strips would have beneficial effects on both species by allowing no or, at most, only very limited vegetation management and, so, allowing forests to mature in these areas.

MO and NM management areas under Alternatives 2, 3 and 4 would be beneficial for both species in the long term. Restoration of bottomland-forest habitats in the floodplains of major rivers would result in beneficial, indirect effects for both species. The development of mature and old-growth, floodplain-forest habitats in the long term in NM management areas would have indirect, beneficial effects on both species. CH, FI and RW management areas would provide additional mature and old-growth bottomland and upland forests in the long term and have beneficial, indirect effects on both species under Alternative 1.

Under any alternative, timber harvest would not be done in any of the known habitats for either species and, so, would have no direct effects on existing populations of the species. There would be no effects on the species from timber harvest under Alternative 3, since no harvest is allowed under this alternative. Harvest in potential habitats (large blocks of mature hardwoods) across the Forest under Alternatives 1, 2, and 4 could have adverse, direct and indirect effects on the cerulean warbler in the short term by removing potential nest-sites and causing some opening of the canopy and possible attraction of cowbird parasitism. In the long term, timber harvest and management in potential habitats under Alternatives 1, 2 and 4 would result in mature-hardwood forests with multi-layered canopies and, so, higher-quality nesting-habitats.

Implementation of any of the alternatives would increase the acreage of old-growth hardwood forests, benefiting both species. Alternatives 2, 3 and 4 would incorporate forest-interior management strategies on more acreage than under Alternative 1. More acres would be managed to reduce fragmentation and maintain mature oak-hickory forests in the future under Alternatives 2 and 4 than under Alternatives 1 and 3. Under Alternatives 2 and 4, forests would also be mostly oak-dominated, including mature white oak in the overstory, a preferred tree-species for cerulean warbler nesting in southern Illinois (Robinson, personal communication).

Vegetation management, including timber-stand improvement, thinning and reforestation, in former wildlife openings and openlands under Alternatives 1, 2 and 4, in the CV and CR management areas would improve nesting-habitat quality and quantity for the Swainson's warbler, reduce fragmentation, and maintain the abundance of mature oak species for the cerulean warbler. These activities would have beneficial, indirect effects on both species in the short and long term.

Fire management—predominantly prescribed fire—should have no direct or indirect effects on the cerulean warblers in the short term, as nests or habitats would not be directly affected. In the long term, both activities would have a beneficial, indirect effect on the species as mature, oak-dominated forests (including white oak) would be maintained and/or restored by these practices. Prescribed fire in suitable floodplain forests would have no adverse, direct effects on Swainson's warbler in the short term, since no burning would be done in nesting season in known habitats of the species. By reducing understory densities, burning could have adverse, indirect effects on potential habitats for the species in the short term. In the long term, understory densities could improve following burning treatments and have a beneficial, indirect effect on the species.

Wildlife-opening management would not occur in any of the known habitats for either species and, so, would have no effects on either. The openings would be eliminated or reduced in all potential habitats under Alternatives 2 and 3. These two alternatives would have beneficial, indirect effects on both species and their habitats in both the short and long terms.

Under any alternative, roads and trails management and use, and authorized and unauthorized ATV use, could have some adverse, indirect effects on cerulean and Swainson's warblers. This management and use currently occur at low levels in the CV and CR management areas. In all management areas, trail use is restricted near known nest-sites of Swainson's warblers to periods after the nesting season in all management areas to reduce effects. Nest-site abandonment from recreational trail use in historical Swainson's warbler habitats has not been documented in previous studies (Eddleman *et al.*, 1980). Well-developed and maintained roads (levels 3, 4 and 5) in known habitats could indirectly increase cowbird parasitism and subsequently affect the nesting success of cerulean warblers; however, few level 3, 4 and 5 roads occur in known habitats of the species and, so, these indirect effects are expected to be small. In areas other than known nesting-sites, any adverse effects on Swainson's warblers from road or trail use are expected to be minor.

e. RFSS of scrub-shrub wetland habitats

(northern copperbelly watersnake)

Any of the alternatives would provide for the viability of the species in the long term with Forest-wide and management-area–specific standards and guidelines, riparian filter-strip guidelines, guidelines for den-site protection and management, and standards and guidelines for the protection and management of existing habitat in management prescriptions FR, NA and CR should provide for the long-term viability of this species. This restrictive management would limit disturbances of the species or its habitat and should have overall, beneficial, direct and indirect effects on the species.

Habitat or populations of the Northern copperbelly watersnake would not be directly or indirectly affected in the short or long term by dispersed recreational use, developed recreational site use, timber harvest, vegetation treatments (timber-stand improvement or reforestation), fire management, integrated pest management, openings and openlands management or minerals management. These activities are restricted from occupied habitat.

The northern copperbelly watersnake would continue to be adversely affected by road use adjacent to swamp or broad-floodplain habitats on the east side of the Forest. A few snakes are killed annually as they cross county and state highways adjacent to these habitats. Management and use of these highways are outside the jurisdiction of the Forest Service and nothing can be done by the agency to prevent these adverse effects. The species persists in adjacent habitats on the Forest despite these adverse, direct effects. The species is not known to be affected by the use of any Forest roads.

The species could also be adversely and indirectly affected by recreational trail use and authorized and unauthorized ATV use, primarily of user-developed trails in or adjacent to swamp habitats on the east side of the Forest. Occasionally, encounters with humans result in the death or injury of individual snakes. This seems to be mainly because of its close resemblence to the venomous cottonmouth, a co-inhabitant of the same swamps. However, trail use is light in these habitats and effects are considered minimal, since the species persists and is relatively common in its swamp habitats.

Aquatic resource management, including pond and waterhole management and maintenance near swamps on the east side of the Forest, is expected to benefit the species indirectly, since these ponds and waterholes, and the frog populations that they support, would continue to provide food and cover for the species. Management of these ponds could have some minimal, adverse, direct and indirect effects on the species from mowing. Individuals could be killed by the mowing or harmed by the reduction of terrestrial cover adjacent to the aquatic habitats. Since few ponds provide habitat for the species, these adverse effects are expected to be minor.

Land-ownership adjustment could have beneficial, indirect effects on the species in both the short and long terms when newly acquired parcels include existing or potential habitat.

f. RFSS of dry, upland-forest habitats

(timber rattlesnake, eastern woodrat)

Neither habitats nor populations of the eastern woodrat would be affected under any alternative by developed recreational site use, integrated pest management, openings and openlands management, aquatic resource management and minerals management. None of these practices are expected to occur in occupied woodrat habitat. Integrated pest management would have no direct or indirect effects on timber rattlesnakes, since these actions would occur in occupied rattlesnake habitats. Under any alternative, restrictive management in floodplains and filter strips and CH, CR, CV, FR, HR, FI, NA, MO, RA, RW, WD and WW management areas could have beneficial, direct and indirect effects on both species in both the short and long terms. The activities prescribed for these management areas would protect, maintain and/or improve existing habitat quality and quantity for both species.

Under any of the alternatives, some minimal, adverse, direct effects on timber rattlesnakes and woodrats could occur as a result of trails and roads management, the recreational use of roads and trails and authorized and unauthorized ATV use adjacent to occupied habitat, dispersed recreational use and timber harvest. These practices could result, in rare instances, in the death of a few individuals, or the disturbance of their nest sites. However, these activities are not expected to result in any effects on either species in the long term, because the habitat area affected would be relatively small and localized. Compliance with Forest-wide standards and guidelines would also protect individuals of both species, especially in areas of heavy trail or road use, as well as associated large populations of either species, such as near LaRue Road.

Timber rattlesnakes and eastern woodrats could be affected directly and indirectly by harvests in mature, upland- and bottomland-hardwood forests and hardwood restorations in pine plantations within 1.5 miles of den-sites or near large, rocky bluffs on the west side of the Forest. Harvesting would have beneficial, indirect effects on both species in both the short and long terms, since early-successional forest habitats with high prey content and brush piles would be developed in the short term, providing abundant food and cover. In the long term, maintenance of mature, oak-hickory forests that are high-quality habitat for timber rattlesnakes would also have beneficial effects on both species. Harvesting activities also could have minimal, adverse, direct effects on a few individuals in the short term from equipment operation in their habitats. Timber rattlesnakes could be affected more than woodrats, although most individuals of both species would avoid areas of high activity during harvest.

Vegetation treatments, including timber-stand improvement and reforestation, would have beneficial, indirect effects on timber rattlesnakes and woodrats, since these actions are done to promote the growth and dominance of oak-hickory forests, habitat for both species. Fire management, including prescribed fire, could have minimal, adverse, direct effects in the short term on a limited number of woodrats and timber rattlesnakes that might be present when upland forests are burned. However, these effects are unlikely since most individuals of both species can and do avoid burning-related disturbances by moving to protective cover: rattlesnakes to dens and woodrats to nests in rocky fissures. Thus, it is expected that most individuals of both species would be unaffected. Prescribed fire in upland and bottomland hardwoods and in openlands would also have beneficial, indirect effects on both species in the long term, since oak-hickory forests and oldfields, preferred habitats for the species, would be maintained.

Under any alternative, openings and openlands management, aquatic resources management, and minerals management would have no effect on the eastern woodrat, since these activities would not occur in habitats for the species. Minerals management would have no measurable effects on the timber rattlesnake because of the limited scale of activities. Openings and openlands management and aquatic resource management in the Mississippi and Big Muddy Rivers floodplains would improve foraging habitats and result in beneficial, indirect effects on timber rattlesnakes in both the short and long terms.

Land-ownership adjustment could have a beneficial, indirect effect on both species in both the short and long terms when newly acquired parcels have existing or potential habitat.

g. RFSS of seep, spring, cave habitats

(subtle cave amphipod)

Under any alternative, restrictive management, roads and trails management, recreational use of trails or roads, authorized and unauthorized ATV use, dispersed recreational use and developed recreational site use and management, timber harvest, vegetation treatments, fire management, integrated pest management, openings and openlands management, aquatic resource management and minerals management are not expected to have any direct effect on the subtle cave amphipod, and beneficial, indirect effects on the species. This is because natural area management and protection for much of the aboveground surface of the cave, and compliance with Forest-wide standards and guidelines, would maintain and improve habitat for the species and provide for its existence on the Forest in the long term.

Land-acquisition under any alternative could result in beneficial, indirect effects in the short and long terms when newly acquired parcels have existing or potential habitat for the species.

h. RFSS of cave and forested-wetland habitats

(southeastern myotis)

Under any alternative, compliance with Forest-wide and management-area-specific standards and guidelines would ensure the protection of occupied habitat—mature floodplain and bottomland forests, riparian corridors and caves. Therefore, the species habitats and populations would not be affected by roads and trails management, recreational use of trails and roads, authorized and unauthorized ATV use, dispersed recreational use, developed recreational site use, timber harvest, integrated pest management, openings and openlands management and minerals management. The restrictive management of caves, floodplain and riparian filter strips, and the FR, CR, NA, CV, MO and WD management areas would indirectly benefit the species in both the short and long term by protecting and improving existing wetland-foraging, summer-roosting and winter-hibernation habitat. Vegetation treatments, primarily reforestation, in floodplains would indirectly benefit the species, as newly developed habitat is occupied.

Under Alternatives 1, 2 and 4, fire management, primarily prescribed fire, could occur in occupied summer habitats for this species and near some hibernation habitats. Prescribed fire has occurred, and could continue to occur, in the understories of upland and bottomland forests immediately adjacent to swamps. Few, if any, measurable, adverse, direct or indirect effects on the species from prescribed fire are anticipated, since relatively few mature trees would be affected. Most burning would be done when the species is in hibernation caves, and areas immediately around cave entrances would be avoided. Burning also would have some beneficial, indirect effects by creating more cavities and hollows in some mature, bottomland trees. Only few individuals are expected to be adversely, directly or indirectly, affected by early-fall or late-spring burning and when only disturbances of a few hours are anticipated. No effects on populations of southeastern myotis are expected in the long term.

Under any alternative, aquatic resource management of streams, lakes and ponds would beneficially and indirectly affect the species in the foraging habitats of the OB as well as MO management areas, primarily related to the permanent wetlands (including borrow pits and some ditches) in Oakwood Bottoms. Land-ownership adjustment could have beneficial, indirect effects in both the short and long terms when newly acquired parcels have existing or potential habitat.

i. RFSS of limestone cliff habitats

(carinate pillsnail)

The only known location of the species and its habitat is the LaRue-Pine Hills/Otter Pond research natural area on the Forest, which is managed to protect, maintain and/or enhance ecological communities. Under any alternative, compliance with Plan standards and guidelines, especially those of the natural area management prescription, would result in beneficial, indirect effects in the short and long terms, ensuring the protection of the species and its habitat.

2. Plants

a. RFSS of barrens habitats

(*Buchnera americana, Corydalis micrantha ssp. australis, Echinacea simulata, Festuca paradoxa, Gentiana alba, Helianthus silphiodes, Hexalectris spicata, Polygala incarnata, Pycnanthemum torrei, Silphium pinnatifidum, and Silphium trifoliatum*)

Under any alternative, restrictive management would have beneficial, direct and indirect effects on all of these barrens plants in the short and long terms, since natural area management would maintain, protect and/or enhance the barrens communities. Roads and trails management, recreational use of trails and roads, authorized and unauthorized ATV use, dispersed recreational use, developed recreational site use, timber harvest, openings and openlands management, aquatic resource management, minerals management and land-ownership adjustment are expected to have no effects on these species, since none would occur in the barrens communities. Vegetation treatments, fire management and integrated pest management would have beneficial, direct and indirect effects in the short and long terms. These activities would provide open, barrens-habitat conditions from landscape-scale burning in surrounding, upland hardwoods, ecological connections between habitats, and corridors to enable the interactions of barrens plant populations and, so, maintain or improve habitats for all the species.

Alternative 3 could have some adverse, direct and indirect effects on all of these species in the long term, due to limitations on the amounts of vegetation treatments and integrated pest management. The effects of Alternative 3 on the barrens plants in natural areas would be the same as Alternatives 1, 2 and 4. However, outside of natural areas, barrens plants would likely be shaded out and lost. There would be no connectivity of populations outside natural areas with populations inside natural areas. Lack of these activities would result in the eventual encroachment of woody species and aggressive native and non-native species, leading to a reduction in the health and vigor of these barrens plants. Many of the barrens on the Forest, including those in south Pope County, are already being invaded by aggressive native and non-native species. The rare barrens-community types are expected to succumb to successional species without intensive management. Open, sunny barrens benefit all of the barrens plant species, and cannot be achieved without prescribed fire and selective tree and shrub removal.

Because of regulatory restrictions on prescribed fire in wilderness, under any alternative there could be adverse, direct and indirect effects on *Echinacea simulata* and *Festuca paradoxa* in the long term where they may occur in wilderness. Adverse, direct and indirect effects could also result under Alternative 3 in the long term if non-native invasive species are not controlled by the use of herbicides when necessary.

b. RFSS of upland and oak-hickory forest habitats

(*Calamagrostis porteri* ssp. *insperata, Carex communis, Cypripedium pubescens, Dichanthelium ravenelii, Pycnanthemum albescens, Trifolium reflexum, Vaccinium stamineum*)

Under any alternative, restrictive management, roads and trails management, recreational use of trails and roads, dispersed recreational use, vegetation treatments, fire management and integrated pest management would have beneficial, direct and indirect effects on all of these species in the short and long terms. Timber harvest, openings and openlands management, aquatic resource management, minerals management and land-ownership adjustment are expected to have no effects on any of the species. Developed recreational site use at Bell Smith Springs and Garden of the Gods, where developed recreation is combined with natural area designation, could have adverse effects on a few of the species.

Habitat changes leading to closed canopies are detrimental to the growth of the species that rely on some direct sunlight and open-woodland habitats. Some populations of these species have been suppressed, and may have been extirpated in some areas of the Forest in recent times, due to the over-shading of an enclosing canopy in some natural areas. These species perform better in open woodlands rather than closed-canopy forest.

Open, oak woodlands presently exist in a number of the natural areas on the east side of the Forest and would continue to be maintained under natural area management under any alternative. Open, sunny woodlands, dominated by native oaks, benefit all of these species. These habitats stimulate germination and seedling-establishment for many of the species. Populations of all of the species would be maintained or improved through use of prescribed fire, which opens up the canopy, reducing competition from other plants. Selective tree and shrub removal may also be necessary to provide optimum conditions in some natural areas for most species. Alternatives 1, 2 and 4 include prescribed fire in natural areas and surrounding hardwood forests, as well as tree and shrub removals and integrated pest management and, so, would be the most beneficial for all species. Alternative 3 does not include the latter two actions outside natural areas and, so, would not be as beneficial for all species.

Because of regulatory restrictions on prescribed fire in wilderness, under any alternative there could be adverse, direct and indirect effects on *Carex commuinis* and *Cypripedium pubescens* in the long term where they may occur in wilderness. Adverse, direct and indirect effects could also result under Alternative 3 in the long term if non-native invasive species are not controlled by the use of herbicides when necessary.

c. RFSS of dry-mesic and mesic hardwood-forest habitats

(*Carex oxylepis* var. *pubescens, Carex socialis, Chamaelirium luteum, Cimicifuga rubifolia, Cladrastis kentukea, Lilium superbum, Oxalis illinoensis, Panax quinquefolius, Poa alsodes, Silene ovata, Styrax grandifolius, Synandra hispidula*)

Under Alternative 1, adverse, direct and indirect effects are expected from the recreational use of trails and roads and dispersed recreational use. Some populations of these species are not protected by natural area management and are being affected by unregulated, recreational use on user-developed trails. Many of these species are isolated and restricted to a few populations on the Forest. Continued adverse effects on unprotected populations could cause a trend to federal listing, or loss of species viability. Implementation of Alternative 2, 3 or 4 would have no effects or only beneficial effects on the species since recreational trail use is required to be on designated and managed trails.

Under any alternative, restrictive management is expected to have beneficial, direct and indirect effects on all of the species in the short and long terms. Roads and trails management, developed recreational site use, timber harvest, openings and openlands management, minerals management and land-ownership adjustment are expected to have no effects on these species, since none of these actions is planned in habitats where they occur, or would not be mitigated by compliance with Forest-wide standards and guidelines.

Under Alternatives 1, 2 and 4, vegetation treatments, dispersed recreational use, fire management, aquatic resource management and integrated pest management are expected to have beneficial, direct and indirect effects in the short and long terms. Adverse effects are expected under Alternative 3, because vegetation treatments, fire management and integrated pest management would not allowed outside of natural areas, which would lead to the eventual encroachment of non-native invasive species. This could cause a reduction in the health and vigor of populations of some of these species on the Forest.

Because of regulatory restrictions on prescribed fire in wilderness, under any alternative there could be adverse, direct and indirect effects on *Cimicifuga rubifolia* in the long term where they may occur in wilderness. Although *Cimicifuga* is not known to require fire, the surrounding vegetation can become so dense, without burning, that the species is shaded from the sunlight it requires. Adverse, direct and indirect effects could also result under Alternative 3 in the long term if non-native invasive species are not controlled by the use of herbicides when necessary.

Under any alternative, the collection of *Panax* is prohibited; however, unauthorized collections continue at low to moderate levels. These collections could have adverse, direct and indirect effects on the species.

d. RFSS of wetlands habitats

(*Amorpha nitens, Carex decomposita, Carex gigantea, Carex lupuliformis, Chelone obliqua* var. *speciosa, Dichanthelium joorii, Dichanthelium yadkinense, Eleocharis wolfii, Heteranthera reniformis, Hottonia inflata, Juglans cinerea, Lysimachia fraseri, Phaeophyscia leana, Plantago cordata, Platanthera flava* var. *flava, Rhynchospora glomerata, Schoenoplectus purshianaus, Stenanthium gramineum, Vitis rupestris*)

Under any alternative, restrictive management and aquatic resource management are expected to have beneficial, direct and indirect effects on all of these species in the short and long terms. Roads and trails management, recreational use of trails and roads, dispersed recreational use, developed recreational site use, timber harvest, openings and openlands management, minerals management and land-ownership adjustment are expected to have no effects on these species, since none of these actions is planned in habitats where they occur, or would not be mitigated by compliance with Forest-wide standards and guidelines. Under Alternatives 2, 3 and 4, MO management would result in improvements of floodplain and swamp habitats in the Mississippi River and Big Muddy River floodplains in the long term.

Under Alternative 1, 2 or 4, vegetation treatments, fire management and integrated pest management are expected to have beneficial, direct and indirect effects for most of these species in the short and long terms, by keeping small canopy-openings in these communities. Under Alternative 3, there would be some adverse, direct and indirect effects on most of the species in the long term. These would result from the eventual encroachment of non-native invasive species, leading to a reduction in health and vigor of species populations on the Forest.

Because of regulatory restrictions on prescribed fire in wilderness, under any alternative there could be adverse, direct and indirect effects on *Lysimachia fraseri* in the long term where they may occur in wilderness. Although *Lysimachia* is not known to require fire, the surrounding vegetation can become so dense, without burning, that the species is shaded from the sunlight it requires. Adverse, direct and indirect effects could also result under Alternative 3 in the long term if non-native invasive species are not controlled by the use of herbicides when necessary.

e. RFSS of cliff habitats

(*Asplenium bradleyi, Asplenium resiliens, Berberis canadensis, Dodecatheon frenchii, Lonicera dioica* var. *glaucescens, Lonicera flava, Trichomanes boschianum, Waldsteinia fragarioides*)

Under any alternative, restrictive management would have beneficial, direct and indirect effects on all of these species in the short and long terms. Timber harvest, openings and openlands management, aquatic resource management, minerals management, roads and trails management, recreational use of trails and roads, dispersed recreational use, developed recreational site use and land-ownership adjustment would have no effects on the species, since these activities would not occur in their habitats or would be mitigated by compliance with Plan standards and guidelines. Only *Dodecatheon frenchii*, which occurs at the base of bluffs along the drip-line, could be adversely affected in the long term by dispersed recreational use.

Under any alternative, vegetation treatments, fire management and integrated pest management are expected to have beneficial, direct and indirect effects for all the species in the short and long terms. However, fire could have some adverse, direct effects on some species in the short and long terms if the surrounding forest or that forest on the bluffs results in drying and erosion; on the other hand, beneficial effects could result from the nutrients added to the microhabitat (Hill, 2003a). The effects of fire are not well-studied on many of the cave species, but some have persisted and maintained their abundance where prescribed fires have burned on or adjacent to cliff habitats, such as in the Cave Hill Research Natural Area. With the current information available, fire appears to have no effect on the population of cliff-habitat species on the Forest.

Under Alternative 3, which does not allow pesticide use, there could be some adverse, direct and indirect effects on some species in the long term from the eventual encroachment of non-native invasive species, which could cause a reduction in the health and vigor of the populations of some of these species on the Forest. The spread of Japanese honeysuckle, Virginia creeper and poison ivy on rock faces where these populations occur could become detrimental to some of the species, as well as excessive shading from trees above the cliff face and at the base of the cliffs.

f. RFSS of spring and seep habitats

(*Bartonia paniculata, Isotria verticillata, Platanthera clavellata, Rudbeckia fulgida* var. *sullivantii, Sagittaria australis, Thelypteris noveboracensis*)

Under any alternative, restrictive management, especially in natural areas, is expected to have beneficial, direct and indirect effects on all of these species in the short and long terms. Roads and trails management, recreational use of trails and roads, dispersed rec. use, developed rec. site use, timber harvest, openings and openlands management, aquatic resource management, minerals management and land-ownership adjustment are expected to have no effects on these species, since none of these activities would occur in the seep and spring habitats, or they would be mitigated by compliance with Plan standards and guidelines. Under Alternative 1, 2 or 4, vegetation treatments, fire management and integrated pest management are expected to have beneficial, direct and indirect effects in the short and long terms. Fire is known to be beneficial for these species and their habitat on the Forest. Seep-springs occur adjacent to fire-dependent communities and would be burned periodically. The seep-springs on the Forest are habitats for several native fire-adapted species.

Under Alternative 3, there could be some adverse, direct and indirect effects in the long term from the eventual encroachment of non-native invasive species, which could not only cause a reduction in the health and vigor of populations within the seep springs on the Forest, but could lead to the extirpation of some of these species in Illinois. In particular, Japanese honeysuckle and Eulalia (*Microstegium vimenium*) could become detrimental to some species, as well as the excessive shading from trees in the overstory and saplings and shrubs in the understory.

Hydrological disturbances that lead to the drying out of these seep springs are a primary threat to some of these species; Massac Tower Springs is all but dried out and the invasive *Eulalia* has taken over portions of the former seep spring habitat. A large population of *Eulalia* found within the Kickasola barrens is migrating towards the seep-springs and is expected to lead to the demise of this seep habitat. Many of the seep-springs have already become invaded by exotic species, and these rare community-types would be lost from the Forest if intensive management is not implemented. Open, sunny seep-springs are beneficial to most of these species and cannot be achieved without prescribed fire and selective tree and shrub removal, as planned under Alternatives 1, 2 and 4.

CUMULATIVE EFFECTS ON RFSS

This discussion of cumulative effects takes into consideration the past, present and reasonably foreseeable future actions specified at the beginning of Chapter 3, principally those discussed below.

All RFSS have been, and will be, affected to some degree by some or all of the past, present, and future land use and management actions within the Forest boundary and in southern Illinois. Past actions on or near, or preceding the management of, the SNF include farming, grazing and clearing of forest and oldfields for agriculture and residential developments; pine and hardwood plantations and timber harvest; recreational facility construction and maintenance; road construction, maintenance and use; designation of natural areas (including management and maintenance by IDNR of state “natural areas”; powerline construction and right-of-way maintenance; wilderness designation and management; use of user-developed equestrian and hiker trails; use of unauthorized user-developed ATV trails; increased equestrian-trail use, especially in the last ten years; mining; tree-planting and timber-stand improvements, including thinning and use of herbicides to reduce vegetative competition; use of four-wheel drive and sport-utility vehicles, trucks and off-highway motorcycles; outdoor recreational uses such as hunting, fishing and hiking; fire use and suppression; construction and management of openings and openlands; compliance with mangement standards and guidelines directed at improving habitat for at-risk species; pond and waterhole construction and management; levee construction and railroad construction and use.

Present actions in the planning area include trail construction, maintenance and use; designation of equestrian-confinement areas; powerline construction and right-of-way maintenance; prohibition of ATV and off-highway motorcycle use; timber harvest (predominantly on private lands); management of the Dixon Springs Agricultural Center; agricultural management (row-cropping and pasturing) on private lands; fire use and suppression; use of user-developed equestrian trails; road maintenance and use; tree-planting; railroad maintenance and use; trail maintenance and rehabilitation; continued and increasing equestrian use; developed recreational facility management and use; wilderness management; marking of natural area boundaries; and outdoor recreational use such as hiking, hunting and fishing.

Future actions on state, private and Forest lands within and near the proclamation boundary are expected to include most of the past and present actions, as well as those proposed in the alternatives.

1. Wildlife and Fish

All Alternatives

i. RFSS of swamp habitats

(bird-voiced tree frog, bantam sunfish, bluehead shiner)

Since more than 66 percent of their habitats in southern Illinois is on the Forest, the cumulative effects of all the alternatives on habitats of bluehead shiner and bantam sunfish would be similar to the direct and indirect effects (Ranvestel and Burr, 2002 and Zeiman and Burr, 2004). Past actions and possible future actions associated with an active rail-line and an explosives factory adjacent to the habitat of both species at Otter Pond and Wolf Lake has had, and continues to have, the possibility of adversely affecting these swamp habitats. The past extirpation of the bluehead shiner from these habitats was the result of a train wreck and chemical spill in Wolf Lake. To date, efforts to reintroduce the bluehead shiner by fisheries researchers from southern Illinois and the Forest have failed, even though the habitat appears to be structurally and chemically acceptable for the species in the swamp areas.

Considering these past, present and reasonably foreseeable future actions and their effects on and around the Forest, the actions proposed under any alternative are expected to have minimal cumulative effect on bantam sunfish. Self-sustaining local and regional populations would continue to be isolated by fragmentation and the rarity of habitats. Local populations of bantam sunfish would continue to be susceptible to extirpation from the indirect, contaminating effects of railway use and the explosives factory. The species currently is considered extirpated from Illinois (Ranvestel and Burr, 2002). Table 3-25a presents a summary of effects on the bantam sunfish.

Table 3-25a. Summary of effects under all alternatives on the bantam sunfish.

Current condition of population: Populations are relatively small and self-sustaining; interacting, but susceptible to local extirpation from actions on adjacent private land.
Current condition of habitat indicators: Acreage of managed LaRue Swamp and Otter Pond: 750 (on the Forest); acreage on private land at Wolf Lake (adjacent to the Forest): 100.
All effects on species and habitat-indicators under any alternative: Same as the current condition.

Considering these past, present and reasonably foreseeable future actions and their effects on and around the Forest, the actions proposed under any alternative are expected to have beneficial, cumulative effects on the bluehead shiner, with the reestablishment of viable populations on Forest in two of its three historic swamp habitats. However, reestablished populations would be small and fragmented associated with the small size and rarity of remnant swamps and would continue to be susceptible to local extirpations from the indirect, contaminating effects of railway use and the explosives factory. Table 3-25b presents a summary of effects on the bluehead shiner.

Table 3-25b. Summary of effects under all alternatives on the bluehead shiner.

Current condition of population: Populations are extirpated in southern Illinois and on the Forest.
Current condition of habitat indicators: Acreage of managed LaRue Swamp and Otter Pond: 750 (on the Forest); acreage on private land at Wolf Lake (adjacent to the Forest): 100.
All effects on species under any alternative: Populations re-established and relatively small; self-sustaining and interacting, but susceptible to local extirpation from actions on adjacent private land.
All effects on habitat-indicators under any alternative: Same as current condition.

Considering these past, present and reasonably foreseeable future actions and their effects on and around the Forest, the actions proposed under any alternative are expected to have beneficial, cumulative effects on the overall populations of bird-voiced treefrogs in southern Illinois would be minimal. Large populations of the species occur on other public ownerships in southern Illinois and populations on the Forest would be self-sustaining, but isolated from other swamp habitats in southern Illinois. Table 3-25c presents a summary of effects on the bird-voiced treefrog.

Table 3-25c. Summary of effects under all alternatives on the bird-voiced treefrog.

<table>
<tr><td colspan="4">Current condition of population: Populations are relatively large in some locations on the Forest and small in others. There are few, if any, interactions among populations on the Forest or in southern Illinois. Overall, populations on the Forest are self-sustaining but isolated.</td></tr>
<tr><td colspan="4">Current condition of habitat indicators: Acres of managed perennial, wetland habitats and swamps: 1,000 (in NA, FR, CR or MO management areas and/or protected by riparian/floodplain filter strips),</td></tr>
<tr><th>Alternative 1
Effects on species</th><th>Alternative 1
Effects on habitat indicators</th><th>Alternatives 2, 3 and 4
Effects on species</th><th>Alternatives 2, 3 and 4
Effects on habitat indicators</th></tr>
<tr><td>Same as existing, except possibly more interaction between populations in the Mississippi River flood-plain as a result of land acquisition and restoration.</td><td>Acres of perennial, wetland habitats and swamps in NA, FR, CR or MO management areas and/or protected by riparian/floodplain filter strips: 2,000 (in Mississippi River floodplain as a result of land acquisition and restoration.</td><td>Same as under Alternative 1, except more interaction among populations in the long term due to MO management area direction and subsequent actions.</td><td>Acres of perennial, wetland habitats and swamps in NA, FR, CR or MO management areas and/or protected by riparian and floodplain filter strips: 2,000 (in Mississippi River floodplain as a result of land acquisition and restoration in MO management areas.</td></tr>
</table>

Swamp habitats on the Forest would be maintained and improved under all alternatives by the proposed management that would maintain or improve the ecological conditions of existing cypress-tupelo swamps. All these swamps are in the NA, FR or MO management areas, or protected by riparian filter-strip and floodplain standards and guidelines. Generally, the species in other public ownerships would be protected by either the IDNR or the US Fish and Wildlife Service and unaffected by Forest management.

ii. RFSS of stream habitats

(Indiana crayfish, Kentucky crayfish, bigclaw crayfish)

Considering these past, present and reasonably foreseeable future actions and their effects on and around the Forest, the actions proposed under any alternative are expected to result in cumulative effects similar to the direct and indirect effects; however, effects on regional populations of the crayfish species would be minimal. This is because other populations of Indiana crayfish are known on the Hoosier National Forest, Kentucky crayfish are found in Michigan and Kentucky, and populations of bigclaw crayfish are found in Alabama, Kentucky and Tennessee. Indiana and Kentucky crayfish are endemic to the Hoosier-Shawnee Assessment area, and both are endangered species in Illinois, as is the bigclaw crayfish.

Small amounts of habitat on private land are likely suitable for all crayfish species, and populations may be present off the Forest. In southern Illinois, past, present and reasonably foreseeable future actions off the Forest—channelization, stream-impoundment, past minerals management on private lands, and sedimentation from associated land use—would likely minimize available habitat and restrict most populations to streams on the Forest.

Table 3-26a. Summary of effects under all alternatives on Indiana crayfish.

Current condition of population: Populations are in low abundance, isolated on the Forest and restricted to the Saline River watershed; but are considered stable in Illinois and on the Forest (Taylor, 2002).		
Current condition of habitat indicators: Habitat is of good quality but not abundant and is isolated on the Forest due to past habitat degradations on private land in the lower reaches of the Saline River.		
All effects on species under any alternative: Same as current condition.		
Alternatives 1 and 4 **Effects on habitat indicators**	**Alternative 2** **Effects on habitat indicators**	**Alternative 3** **Effects on habitat indicators**
Minimal adverse, indirect effects on local stream habitats near areas of abundant user-developed trails and use. Past alterations of habitat quality from mining continue to fragment habitat on and off the Forest.	Beneficial effects on habitats from lack of user-developed trails rehabilitation of former user-developed trails. Local populations remain isolated due to habitat alterations from historical mining in lower Saline River drainage.	Same as under Alternative 2, except that lack of chemical control of non-native invasive species could limit quality of habitats in the long term.

Considering these past, present and reasonably foreseeable future actions and their effects on and around the Forest, the actions proposed under any alternative are expected to maintain populations of the Indiana crayfish on the Forest, in Illinois and within the Assessment area. No effect is expected on population-interaction, since habitats are isolated in sections of the upper Saline River watershed. Populations of the Kentucky and bigclaw crayfish would remain self-sustaining and interactive throughout the Big Creek watershed, but in low abundance on the Forest and in Illinois. Most populations in the Assessment area would remain stable but continue to be fragmented and isolated. Tables 3-26a and 3-26b present summaries of the effects on the Indiana crayfish and the Kentucky and bigclaw crayfish, respectively.

Table 3-26b. Summary of effects under all alternatives on Kentucky and bigclaw crayfish.

Current condition of population: Populations are in low abundance and restricted to Big Creek NA and watershed on the Forest. Populations are considered stable in Illinois and on the Forest (Taylor, 2002).	
Current condition of habitat indicators: Habitat in Big Creek watershed, both on and off the Forest, is of good quality and locally abundant.	
All effects on species under any alternative: Same as current condition.	
Alternatives 1, 2 and 4 **Effects on habitat indicators**	**Alternative 3** **Effects on habitat indicators**
Habitat in Big Creek watershed, both on and off the Forest, is of good quality and locally abundant.	Habitat in Big Creek watershed, both on and off the Forest, is of good quality and locally abundant. Lack of chemical control of non-native invasive species could limit habitat-quality for both species in the long term.

iii. RFSS of openlands habitats

(Henslow's sparrow, migrant loggerhead shrike)

Considering past, present and reasonably foreseeable future actions and their effects on and around the Forest, the actions proposed under any alternative are expected to result in cumulative effects on habitats for both species similar to the direct and indirect effects. Crop-field and pasture management on private lands within the Forest boundary would continue to provide some habitat for both species, but less than was provided in the past, especially for the migrant loggerhead shrike. Large grasslands and oldfields on state and other federal lands (Cypress Creek and Crab Orchard National Wildlife Refuges) and abandoned coal mines would continue to provide habitat for both species in southern Illinois in the future.

Table 3-27a. Summary of effects under all alternatives on Henslow's sparrow.

Current condition of population: Populations are restricted to approximately 2-3 large openlands on the east side of the Forest in Johnson and Pope counties. These populations are in low abundance and dependent on frequent vegetation management in these habitats. Populations are increasing in southern Illinois, but not on the Forest (Burhans, 2001).			
Current condition of habitat indicators: Habitat is of good quality where management has occurred regularly in openlands and oldfields. Elsewhere on openlands on the Forest it is declining in large openlands where less management has occurred. It is best on the Forest in western Pope and Eastern Johnson counties.			
Alternatives 1, 2 and 4 **Effects on species**	**Alternatives 1, 2 and 4** **Effects on habitat indicators**	**Alternative 3** **Effects on species**	**Alternative 3** **Effects on habitat indicators**
Populations are increasing in 13 large, managed openlands on both the east and west sides of the Forest. Populations in s. Illinois are increasing in large grasslands on state and federal lands and private, restored, deep-mined land.	Habitat is increasing in quality and quantity in 13 large openlands on both the east and west sides of the Forest in areas identified by the Central Hardwood Joint Venture as regional habitats for grassland and shrubland birds.	Same as the current condition in the short term; extirpated in the long term due to lack of openland management. Populations less well-distributed and decreasing in southern Illinois.	Habitat is declining in quality and quantity in both the short and long term.

Implementation of Alternative 1, 2 or 4 would result cumulatively in small populations of both species on the Forest associated with management of openlands on and off the Forest. Implementation of Alternative 3 would result cumulatively in the loss of all populations of both species on the Forest. Viable populations of both in southern Illinois, and regionally in the Assessment area, would persist under all alternatives, albeit with overall lower populations and poorer distribution than under Alternative 1, 2 or 4. Tables 3-27a and 3-27b present summaries of the effects on Henslow's sparrow and the migrant loggerhead shrike.

Table 3-27b. Summary of effects under all alternatives on migrant loggerhead shrike.

Alternatives 1 and 4 Effects on species	Alternatives 1 and 4 Effects on habitat indicators	Alternative 2 Effects on species	Alternative 2 Effects on habitat indicators	Alternative 3 Effects on species	Alternative 3 Effects on habitat indicators
Current condition of population: Populations on the Forest are restricted to one large-openland site (Pennant Bar Ranch) and in low abundance. Populations are more widespread in southern Illinois but still in low abundance (Barbour and Mohr, 2002).					
Current condition of habitat indicators: Habitat is good quality but restricted on the Forest to only one large openland.					
Populations are increasing in a few large openlands on Forest in long term with management to maintain habitats. Populations in southern Illinois remain scattered and few.	Habitat quality and quantity improve in managed open-lands; in southern Illinois declines as cropfields succeed to forest on state and federal lands. Habitats on private agricultural lands associated with CRP programs are maintained.	Same as under Alternatives 1 and 4.	Habitat in Big Creek watershed both on and off Forest is of good quality and locally abundant.	Populations declining significantly on Forest and slightly in southern Illinois with lack of openland management.	Habitat declining in quality and quantity on Forest and other state and federal lands due to forest succession. Remain same as current condition on private agricultural lands in southern Illinois associated with the CRP programs.

Table 3-28a. Summary of effects of alternatives on cerulean warbler.

Alternative 1 Effects on species	Alternative 1 Effects on habitat indicators (in decades 2 and 10)	Alternatives 2 and 4 Effects on species	Alternatives 2 and 4 Effects on habitat indicators (in decades 2 and 10)	Alternative 3 Effects on species	Alternative 3 Effects on habitat indicators (in decades 2 and 10)
Current condition of population: Populations are moderate to high and more well-distributed in appropriate habitats on the west side of the Forest, and more isolated and in lower abundance on the east side. Populations are generally declining in Illinois and upper Midwest, but appear to be stable in southern Illinois and on the Forest (200-500 individuals) (Burhans et al., 2002).					
Current condition of habitat indicators: Habitat on the Forest is scattered and maturing as the Forest ages. Habitat is of good quality, especially on the west side, with larger, contiguous blocks of hardwood forest, including bottomland and floodplain forests. Mature-hardwood forest acreage: 191,900; old-growth hardwood forest acreage: 0; old-growth oak-hickory forest acreage: 0.					
Same as current condition, except populations on the Forest improved due to improvements of habitat quality and quantity.	Mature-hardwood forest acreage: 200,200 and 234,700. Old-growth, hardwood forest acreage: 0 and 188,500. Old-growth, oak-hickory forest acreage: 0 and 118,600.	Same as current condition, except populations on the Forest improved due to improvements of habitat quality and quantity.	Mature hardwood forest acreage: 200,900-201,000 and 182,800-187,600. Old-growth, hardwood forest acreage: 0 and 128,700-130,100. Old-growth, oak-hickory forest acreage: 0 and 72,400-74,800.	Same as Alternative 1 in the short term; less improvement In the long term as, overall, oak-hickory forest type declines.	Improvement of habitat quality and quantity in the short term; less improvement in the long term as oak-hickory forest-types decline. Mature hardwood forest acreage: 200,600 and 261,100. Old-growth, hardwood forest acreage: 0 and 223,900. Old-growth, oak-hickory forest acreage: 0 and 106,600.

Table 3-28b. Summary of effects of alternatives on Swainson's warbler.

Current condition of population: Populations on the Forest are restricted to the Cave Valley management area. They are in low abundance or extirpated on the Forest and throughout southern Illinois (Kleen *et al*., 2004).					
Current condition of habitat indicators: Known habitat is limited in quantity and quality and continues to decline lacking disturbance. Potential habitats, especially in CR management areas are improving in quantity and quality. Mature, riparian deciduous hardwood forest acreage: 7,100.					
Alternative 1 **Effects on species**	**Alternatives 1 and 4** **Effects on habitat indicators**	**Alternatives 2 and 4** **Effects on species**	**Alternative 2** **Effects on habitat indicators (in decades 2 and 10**	**Alternative 3** **Effects on species**	**Alternative 3** **Effects on habitat indicators (in decades 2 and 10**
Same as current condition, except population maintained at low levels or improved slightly with management.	Potential habitats in southern Illinois generally improved, especially on state and other federally managed lands. Mature, riparian-hardwood forest acreage: 7,100.	Populations increased on the Forest and in southern Illinois with management on the Forest, state and other federal lands.	Same as under Alternatives 1 and 4.	Same as current condition, with extirpation on the Forest likely. Species breeding in southern Illinois on state or other federal land, but would remain in low abundance.	Known and potential habitats on Forest would decline in quality and quantity with no vegetation disturbances. The quality of known or potential habitats on state and other federal lands in southern Illinois improved. Mature, riparian-hardwood forest acreage: 7,100.

iv. RFSS of mature-bottomland and floodplain-forest habitats

(cerulean warbler, Swainson's warbler)

The clearing of floodplain forests primarily for agriculture in southern Illinois has limited the habitats for both species to fragments and remnants, and historically reduced the populations of both species within or adjacent to the Forest boundary. Most of the habitat remnants for both species occur on the Forest or in state or other federal ownership in southern Illinois. Management of these remnants is currently, and will continue to be, directed to maintaining or improving habitat conditions for both species. Management of private land continues, as in the past, to fragment the floodplains, primarily from agriculture. Management of upland habitats on private lands with grain and livestock farming near known cerulean warbler habitats on the Forest would continue the fragmenting effects on nearby Forest lands.

Considering past, present and reasonably foreseeable future actions and their effects on and around the Forest, the effects of actions proposed under any alternative are expected to result cumulatively in localized improvements of habitats for both species on Forest, state and other federal lands with known or potential habitats for the species in southern Illinois, but minimal cumulative effects on the populations of either species, which would continued to be rare and in low to moderate abundance on the Forest and in southern Illinois. Tables 3-28a and 3-28b present summaries of the effects on the cerulean warbler and Swainson's warbler, respectively.

v. RFSS of scrub-shrub wetland habitats

(northern copperbelly watersnake)

There are a few privately owned and managed swamps adjacent to those on the Forest. Much of the larger stream and river floodplains adjacent to habitats on National Forest in Johnson, Saline, Pope, Massac, Gallatin and Hardin Counties are privately owned. Farming activities and associated, increased sedimentation in or adjacent to swamps and floodplains has had, and continues to have, adverse, indirect effects on the species, primarily due to reductions in water quality and subsequent reductions in aquatic prey and vegetation—food and cover for the species. As discussed above, state and county roads and their use and management adjacent to swamps and floodplains continue to have adverse, direct effects on the species through associated snake mortality.

The adverse effects of these past and present actions on private lands have resulted in the situation wherein the only quality habitats for the species within the Forest boundary are in swamps and floodplains of perennial streams and rivers on the Forest or other public lands. Although these habitats on the Forest are minimally adversely affected by these actions, they are still the best habitats for the species and harbor the largest populations within the Forest boundary. Therefore, considering these past, present and reasonably foreseeable future actions, both on and near the Forest, implementation of any of the alternatives is expected to result in cumulative effects similar to the direct and indirect effects: populations of the species within the Forest boundary would be maintained or enhanced. Table 3-29 presents a summary of effects on the northern copperbelly watersnake.

Table 3-29. Summary of effects of alternatives on northern copperbelly watersnake.

Current condition of population: Populations are restricted to the east side of the Forest, associated with wetland and floodplain habitats and nearby rock-outcrops and bluffs. Known populations in four swamp areas on the Forest appear to be stable, but in low abundance. (Swamps are connected by Bay and Sugar creek drainages.) There could also be populations in wetlands and floodplain forests on the Forest associated with lower reaches of perennial streams and the Ohio River floodplains.
Current condition of habitat indicators: Habitat is of good quality on the Forest but patchy and discontinuous in some places, due to private land inholdings. Habitats in remaining areas of southern Illinois are good and extensive on state and federal lands on the Cache River and in some state natural areas adjacent to the Forest in Massac and Johnson Counties. Habitat quality and quantity is good on these ownerships. Overall habitat quality in southern Illinois continues to decline due to agricultural activities on and/or near privately owned swamps and floodplains. Estimated acreage of floodplains and swamps on the east side of the Forest: 500 acres in swamps, 2,800 acres in bottomland-floodplain forest.
All effects on species and habitat-indicators under any alternative: Same as the current condition.

Table 3-30a. Summary of effects of alternatives on timber rattlesnake.

Current condition of population: Populations throughout the range of the species in southern Illinois have declined from historical levels, especially on private lands. Populations on west side of Forest are generally well- distributed, interactive, stable and in medium-to-high abundance. Populations on east side are distributed as patches, in most cases isolated and not interactive. They are less stable and in low abundance.

Current condition of habitat indicators: Habitat on the Forest is of good quality, but declining as oak-hickory forests are decline. It is of highest quality and most contiguous on the west side of the Forest. Habitat on private land in southern Illinois is declining, but stable to increasing on state and other federal lands. Acreage of upland and bottomland oak-hickory forests and woodlands: 192,800.

Alternative 1 Effects on species	Alternative 1 Effects on habitat indicators (in decades 2 and 10)	Alternatives 2 and 4 Effects on species	Alternatives 2 and 4 Effects on habitat indicators (in decades 2 and 10)	Alternative 3 Effects on species	Alternative 3 Effects on habitat indicators (in decades 2 and 10)
Same as current condition.	Habitat is increasing in quality but declining slightly in quantity on the Forest in both short and long terms, due to openlands management, timber harvest, vegetation treatments and prescribed fire to maintain oak-hickory forests. Acreage of upland and bottomland oak-hickory forests and woodlands: 191,600 and 182,900.	Same as current condition.	Same as current condition, except there is less decline in oak-hickory forests in both the short and long term. Acreage of upland and bottomland oak-hickory forests and woodlands: 194,300-196,200 and 197,300-199,200.	Same as current condition, except population declines on the Forest in the long term with pronounced declines in oak-hickory forests.	Habitat is declining in quality and quantity on the Forest in the long term. Acreage of upland and bottomland oak-hickory forests and woodlands: 198,700 and 139,700.

Table 3-30b. Summary of effects of alternatives on eastern woodrat.

Current condition of population: All extant populations in Illinois are restricted to the west side of the Forest, primarily in three natural areas, one of which is isolated. Populations are low in abundance. Efforts to re-establish populations on the east side of the Forest are ongoing.

Current condition of habitat indicators: Habitat is of good quality but declining, as oak-hickory forests and woodlands decline near rock-bluff nesting-sites. All known nesting habitats are managed to protect, maintain, and/or improve ecological communities.

Alternative 1 Effects on species	Alternative 1 Effects on habitat indicators	Alternatives 2 and 4 Effects on species	Alternatives 2 and 4 Effects on habitat indicators	Alternative 3 Effects on species	Alternative 3 Effects on habitat indicators
Same as current condition, except populations are increasing slightly with more extensive management of oak-hickory forests.	Habitat quality, including oak-hickory forests, is maintained near known and some potential nesting habitats. All known nesting habitats are managed to protect, maintain, and/or improve ecological communities.	Same as current condition, except populations are increasing slightly with more extensive management of oak-hickory forests.	Same as under Alternative 1.	Same as current condition.	Same as under Alternative 1, except oak-hickory forests not maintained in potential habitats for the species.

vi. RFSS of dry, upland-forest habitats

(timber rattlesnake, eastern woodrat)

The only habitat remaining for the eastern woodrat in Illinois is on the Forest. Past actions on and near the Forest that affected the species include reforestation, natural area designation and management and dispersed recreation near existing populations. These have had, and continue to have, primarily beneficial, direct and indirect effects on the species. These actions would continue, along with compliance with standards and guidelines for protection of the species and its cliff and cave habitats and woodrat reintroduction efforts. Considering these past, present and future actions, both on and near the Forest, as well as the limited nature of the species' habitats, implementation of any of the alternatives is expected to result in cumulative effects similar to the direct and indirect effects: viable populations of woodrats would be maintained or enhanced, with the largest populations expected under Alternatives 2 and 4, which promote the most oak-hickory forest-habitats near large, rocky bluffs and outcroppings. Tables 3-30a and 3-30b present summaries of the effects on the timber rattlesnake and the eastern woodrat, respectively.

Past, present and future actions on private lands within the Forest boundary and in southern Illinois, including the direct killing of timber rattlesnakes at most den sites on private lands, deforestation of both upland and bottomland forests for grain-crop agriculture, road and railroad construction and use, fire suppression and human developments, have greatly reduced the quality and quantity of timber rattlesnake habitat on private lands. Road construction and use and fire suppression on the Forest have had adverse, direct and indirect effects on habitats of the species, while prescribed fire, timber harvest, openings and openlands management and natural area management have had beneficial effects on the species and its habitat.

vii. RFSS of seep, spring, cave habitats

(subtle cave amphipod)

Toothless Cave historically has had a high level of human disturbance. For example, it is known that dances were once held in the cave, in the distant past. Timber harvest and farming have occurred in the cave watershed and doubtlessly had some effects on groundwater quality in the cave watershed. Presently the cave is gated effectively against human use. Most of the watershed for the cave is forested and undisturbed and, as a result, water quality to the cave is good. The watersheds for karst areas on the west side of the Forest are heavily forested and water quality in these potential habitats for the species is also good. Under any alternative, watershed and cave protection are planned as part of natural area management and standards and guidelines for Toothless Cave and other potential habitats in the karst areas on the west side of the Forest.

Table 3-31. Summary of effects of alternatives on subtle cave amphipod.

Current condition of population: Known populations are restricted to one cave and karst system within Forest boundary on the west side of the Forest. Population in low abundance and appears isolated. Because of its isolation, rarity and low abundance, it is susceptible to extirpation.
Current condition of habitat indicators: Habitat is of good quality but low in quantity; managed as natural area to protect cave and karst habitats.
All effects on species and habitat-indicators under any alternative: Same as the current condition.

Historically, there were more threats to the species and its habitat than exist at present or are anticipated in the future. Considering the past, present and future actions, both on and near the Forest, as well as the limited nature of the species' habitats, implementation of any of the alternatives is expected to result in minimal to unmeasurable, beneficial cumulative effects on the species. The species and its habitat would be maintained, if not enhanced. Table 3-31 presents a summary of effects on the subtle cave amphipod.

viii. RFSS of cave and forested-wetland habitats
(southeastern myotis)

Historically, many of the cypress-tupelo swamps in southern Illinois were drained and cut for timber and wood products and agriculture. Those not totally destroyed retained some of their diversity and are presently in state or federal ownership as refuges, natural areas, nature preserves or the national forest. Most of these places, such as the Cache River, are in the process of ecological recovery and native-forest maturation. In general, management actions on private lands would continue to fragment wetland landscapes and upland- and bottomland-forest habitats surrounding the Forest. Overall, more foraging and roosting habitat for the species has been managed to the benefit of the species in the last ten years in southern Illinois than in the previous hundred. Summer roosting and foraging habitat is expected to continue to increase in the future in southern Illinois, associated with these protected areas on state and federal lands and the restoration efforts within them.

Tripoli mining has developed many, abandoned, underground mines, some of which can provide suitable habitat for the over-wintering and hibernating, cave-dwelling bats. Historically, most caves and cave resources were affected by human disturbances, including the harassment and killing of roosting bats. Today, many caves in southern Illinois are protected by state or federal management; some still occur on private lands, however, with no official protection. For example, a relatively large roost for the species on the Forest has been protected from human disturbance by a protective cave-gate.

Table 3-32. Summary of effects of alternatives on southeastern *myotis*.

Current condition of population: Populations are restricted to swamp and cave habitats in southern Illinois. Populations are in low abundance and considered to be declining on private lands, but increasing on public lands. Populations on the Forest are stable or slightly increasing, patchy in distribution, and in low numbers.
Current condition of habitat indicators: Habitat is good and improving in caves, mines, swamps, and floodplain forests on the Forest.
All effects on species and habitat-indicators under any alternative: Same as the current condition.

Considering the past, present and reasonably foreseeable future actions, both on and near the Forest, as well as the limited nature of the species' habitats, implementation of any of the alternatives is expected to result in beneficial, cumulative effects similar to the direct and indirect effects: habitats and populations on the Forest would be protected. However, the protected habitats on the Forest would not be large enough to maintain viable populations on the Forest alone, but could contribute substantially to the maintenance of viable populations in southern Illinois. Table 3-32 presents a summary of effects on the southeastern *myotis*.

ix. RFSS of limestone cliff habitats

(carinate pillsnail)

Considering past, present and future actions, both on and near this species habitat on the Forest, as well as the extremely limited nature of the species' habitats, implementation of any of the alternatives is expected to result in beneficial, cumulative effects similar to the direct and indirect effects: habitats and populations on the Forest would be protected. Table 3-33 presents a summary of effects on the carinate pillsnail.

Table 3-33. Summary of effects of alternatives on carinate pillsnail.

Current condition of population: opulations appear stable, but are restricted to a 3,500-acre natural area (of which 2,800 are a research natural area) on the west side of the Forest. Population is in low-to-moderate abundance, and isolated. Because of its isolation, rarity and low abundance it is susceptible to extirpation.
Current condition of habitat indicators: Habitat is of good quality but low in quantity.
All effects on species and habitat-indicators under any alternative: Same as the current condition.

2. Plants

All Alternatives

i. RFSS of barrens habitats

(*Buchnera americana, Corydalis micrantha ssp. australis, Echinacea simulata, Festuca paradoxa, Gentiana alba, Helianthus silphiodes, Hexalectris spicata, Polygala incarnata, Pycnanthemum torrei, Silphium pinnatifidum, and Silphium trifoliatum*)

Historically, barrens communities were more widespread and diverse in southern Illinois and on the Forest. Most were farmed or grazed, or both, during European settlement, and burned regularly as part of this early agricultural use. Today, because of these severe alterations, the most-diverse barrens occur on the Forest or state-managed lands. From the establishment of the Forest until the late 1980's, burning was not done in barrens areas. At that time, the remnant barrens in state and federal ownership were reopened with burning and some tree and shrub removal and suppressed barrens plants were released. Burning in most barrens on the Forest has not been done since the mid-1990's, but is planned in the future.

Considering the past, present and reasonably foreseeable future actions both on and off the Forest, as well as the limited nature of the species' habitats, implementation of any of the alternatives is expected to result in generally beneficial, cumulative effects similar to the direct and indirect effects: the species and its habitats would be protected. Table 3-34 presents a summary of effects on RFSS plants of barrens habitats.

Table 3-34. Summary of effects of alternatives on RFSS plant species in barrens habitats.

Current condition of population: Populations of all species are restricted to remnant, barrens communities on state and Forest land in southern Illinois. Populations are mostly distributed as patches and are in low abundance. In some place, such as in south Pope County, populations are interactive.			
Current condition of habitat indicators: Habitat is of good quality where management (fire and tree and shrub removal) has occurred regularly, poor or declining in quality where there has been no, or only sporadic, management. Non-native invasive plant species are beginning to affect some habitats where no integrated control measures have been taken.			
Alternatives 1, 2 and 4 **Effects on species**	**Alternatives 1, 2 and 4** **Effects on habitat indicators**	**Alternative 3** **Effects on species**	**Alternative 3** **Effects on habitat indicators**
Populations of most species are increasing or stable in all managed barrens habitats. Some species within wilderness may decrease because of inability to use fire.	Habitat is increasing or stable in quality and quantity due to landscape-level burning in natural areas and surrounding, upland, hardwood forests. Some habitat within wilderness may decrease due to inability to use fire. Acres of habitat managed with fire, tree/shrub removal, and integrated pest management: 2,700.	Populations of all species are declining in short term, stabilizing in long term following burning allowed in natural areas only. Some species in wilderness may decrease due to inability to use fire and pesticides.	Habitat is declining in quality and quantity in short term and maintained in long term in natural areas. Some habitat in wilderness may decrease because of inability to use fire and pesticides. Acres of habitats managed with fire only: 2,700.

ii. RFSS of upland and oak-hickory forest habitats

(*Calamagrostis porteri* ssp. *insperata, Carex communis, Cypripedium pubescens, Dichanthelium ravenelii, Pycnanthemum albescens, Trifolium reflexum, Vaccinium stamineum*)

Historically, open-oak woodlands and dry-upland forests existed in relatively the same abundance and distribution as they do today; however, they had more-open canopies and diverse understories. Past and present activities, such as timber harvests, grazing, residential development, road and power line development and maintenance, burning and fire suppression, wilderness designation, authorized and unauthorized trail development, use and maintenance and non-native pine plantations have affected these habitats throughout southern Illinois and on the Forest. In the future, these actions are expected to continue under any alternative, both on and off the Forest.

The largest expanses of open, oak woodlands and dry-upland forests in southern Illinois are on the Forest, and the most and largest populations of these plants also occur on Forest. Considering the past, present and reasonably foreseeable future actions both on and off the Forest, as well as the concentration of species' habitats on the Forest, implementation of any of the alternatives is expected to result in generally protective and beneficial, cumulative effects similar to the direct and indirect effects: the species and its habitats would be protected. Table 3-35 presents a summary of effects on RFSS plants of dry-upland and oak-hickory forest habitats.

Table 3-35. Summary of effects of alternatives on RFSS plant species of dry-upland and oak-hickory forest habitats.

<u>Current condition of population</u>: Populations of all species are restricted to oak-woodland and oak-hickory forest communities on state and Forest land in southern Illinois. Populations are broadly distributed and in low abundance. In some instances, populations are interactive.			
<u>Current condition of habitat indicators</u>: Habitat is of good quality where management (fire and tree and shrub removal) has occurred regularly and poor or declining in quality in areas where there has been no management, or only sporadic management. Non-native invasive plant species are beginning to affect some habitats where integrated control measures have been taken.			
<u>Alternatives 1, 2 and 4</u> Effects on species	**<u>Alternatives 1, 2 and 4</u> Effects on habitat indicators**	**<u>Alternative 3</u> Effects on species**	**<u>Alternative 3</u> Effects on habitat indicators**
Populations of all species are increasing in most managed oak woodlands and oak-hickory forest habitats. Populations are not increasing in areas where user-developed trails are affecting local populations. Some species in wilder-ness decreasing because of inability to use fire.	Habitat is increasing in quality and quantity in all managed woodlands and oak-hickory forest habitats, associated with landscape-level burning in natural areas and surrounding, upland hardwood forests. Some habitat in wilderness decreasing due to inability to use fire. Acres of woodlands and oak-hickory forest habitats managed with fire, tree/shrub removal and integrated pest management: 15,000 under Alternative 1, 74,900-76,200 under 2 and 4.	Populations of all species are declining in the short term and stabilized in long term following burning in natural areas only. Some species in wilder-ness decrease because of inability to use fire and pesticides.	Habitat is declining in quality and quantity in the short term and maintained in the long term in natural areas only. Some habitat in wilderness decreasing due to inability to use fire and pesticides. Acres of woodlands and oak-hickory forest habitats managed with fire in natural areas only: 10,000.

iii. RFSS of dry-mesic and mesic hardwood-forest habitats

(*Carex oxylepis* var. *pubescens, Carex socialis, Chamaelirium luteum, Cimicifuga rubifolia, Cladrastis kentukea, Lilium superbum, Oxalis illinoensis, Panax quinquefolius, Poa alsodes, Silene ovata, Styrax grandifolius, Synandra hispidula*)

Historically, dry-mesic and mesic forests existed in relatively the same abundance and distribution as they do today. Past and present activities, such as timber harvests, grazing, residential development, road and powerline development and maintenance, burning and fire suppression, wilderness designation, authorized and unauthorized collection of some species and authorized and unauthorized trail development, use and maintenance have affected these habitats throughout southern Illinois and on the Forest. Future actions under any alternative, both on and off the Forest, are expected to continue most of these actions. Mesic forests (beech maple dominated forests) would increase in the future under any alternative with the most increase predicted under Alternative 3 (Spectrum Runs-planning records).

Table 3-36. Summary of effects of alternatives on RFSS plant species in dry-mesic and mesic hardwood-forest habitats.

Current condition of population: Populations of all species are restricted to mesic forest communities on state and Forest land in southern Illinois. Populations of some are broadly distributed and interactive, but in low abundance, while others are distributed as patches and in low abundance. Some populations and individuals of some species are adversely affected by user-developed trails outside of natural areas. Populations of ginseng are adversely affected by unauthorized collections.					
Current condition of habitat indicators: Habitat is of good quality, but declining in quantity in areas where non-native invasive species are increasing in the absence of control measures. User-developed trails have degraded some habitats for some species in a few locations.					
Alternative 1 **Effects on species**	**Alternative 1** **Effects on habitat indicators**	**Alternatives 2 and 4** **Effects on species**	**Alternatives 2 and 4** **Effects on habitat indicators**	**Alternative 3** **Effects on species**	**Alternative 3** **Effects on habitat indicators**
Populations of all species are being maintained in natural areas; but some are decreasing outside of these areas due to user-developed trail use. Populations of ginseng are declining due to unauthorized collections. In the long term, at least 1 species in wilderness is adversely affected by lack of prescribed fire to surrounding vegetation.	Habitat is increasing or stable throughout Forest in long term, but decreasing in quality in a few locations associated with user-developed trail use. In the long-term, at least 1 species' habitat in wilderness is adversely affected by lack of prescribed fire to surrounding vegetation.	Populations of all species are being maintained or increasing in natural areas and through-out the Forest. Populations of ginseng are declining due to unauthorized collections. In the long term, at least 1 species in wilderness is adversely affected by lack of prescribed fire to surrounding vegetation.	Habitat is increasing in quantity and quality throughout the Forest in both short and long terms. In the long term, at least 1 species' habitat in wilderness is adversely affected by lack of prescribed fire to surrounding vegetation.	Populations of some species are declining within natural areas and other management areas due to limitations on non-native invasive species control measures and no vegetation treatments. Populations of ginseng are declining due to unauthorized collections. In the long term, at least 1 species in wilderness is adversely affected by lack of prescribed fire to surrounding vegetation.	Habitat is increasing in quantity in the long term and declining in quality in the short and long terms due to lack of vegetation treatments and limited non-native species control. In the long-term, at least 1 species' habitat in wilderness is adversely affected by lack of prescribed fire to surrounding vegetation.

The largest expanses of mesic forests in southern Illinois exist on the Forest, and the most and largest populations of these plants also occur on the Forest. Considering the past, present and reasonably foreseeable future actions both on and off the Forest, as well as the concentration of species' habitats on the Forest, implementation of any of the alternatives is expected to result in generally protective and beneficial, cumulative effects similar to the direct and indirect effects: the species and its habitats would be protected. Table 3-36 presents a summary of effects on RFSS plants of dry-mesic and mesic hardwood-forest habitats.

iv. RFSS of wetlands habitats

(*Amorpha nitens, Carex decomposita, Carex gigantea, Carex lupuliformis, Chelone obliqua* var. *speciosa, Dichanthelium joorii, Dichanthelium yadkinense, Eleocharis wolfii, Heteranthera reniformis, Hottonia inflata, Juglans cinerea, Lysimachia fraseri, Phaeophyscia leana, Plantago cordata, Platanthera flava* var. *flava, Rhynchospora glomerata, Schoenoplectus purshianaus, Stenanthium gramineum, Vitis rupestris*)

Historically, these species and their habitats were affected by hydrological modifications of their normally wet environments, mostly to aid land-clearing for agriculture and settlement. These habitats, both on and off the Forest, were also affected by farming, grazing, timber harvest, flooding from beavers, fire and fire suppression, floods, levees preventing floods, road and railroad developments and maintenance, and powerline development and maintenance. Dams and drainage structures also affect some of the swamp habitats near the Forest. Under any alternative, future actions are expected to continue these actions. Considering the past, present and reasonably foreseeable future actions both on and off the Forest, as well as the concentration of species' habitats on the Forest, implementation of Alternative 1,2 or 4 is expected to result in generally protective, cumulative effects similar to the direct and indirect effects: the species and its habitats would be protected. Implementation of Alternative 3 could result cumulatively in minimal to unmeasurable effects on the species. Table 3-37 presents a summary of effects on RFSS plants of wetland habitats.

v. RFSS of cliff habitats

Asplenium bradleyi, Asplenium resiliens, Berberis canadensis, Dodecatheon frenchii, Lonicera dioica var. *glaucescens, Lonicera flava, Trichomanes boschianum, Waldsteinia fragarioides*

Historical actions in the vicinities of cliff habitats on the Forest have included rock quarrying, residential developments, farming and grazing, trail development and use, fire and fire suppression, rock-climbing, road and powerline development and maintenance and timber harvest. These actions continue today on or near cliffs on the Forest, and are expected to continue. Considering the past, present and reasonably foreseeable future actions both on and off the Forest, as well as the concentration of species' habitats on the Forest, implementation of Alternative 1,2 or 4 is expected to result in generally protective, cumulative effects similar to the direct and indirect effects: the species and its habitats would be protected. Implementation of Alternative 3 could result cumulatively in minimal to unmeasurable, adverse effects on the species, since populations of some cliff species could become over-shaded, suppressed or out-competed by aggressive species. Table 3-38 presents a summary of effects on RFSS plants of cliff habitats.

Table 3-37. Summary of effects of alternatives on RFSS plant species in wetland habitats.

Current condition of population: Populations of some species are restricted to remnant swamp, floodplain forest and wetland communities on state and Forest land in southern Illinois in isolated patches. Populations of some species in riparian forests are more broadly distributed and in low abundance; some are interactive. Some populations are declining due to lack of ecological disturbances, isolation and increases in non-native invasive species. Adverse effects on two species where user-developed trails exist.					
Current condition of habitat indicators: Habitat is of good quality, but affected by adjacent private uses and management. Small increases in floodplain forests, swamps and wetlands through recent acquisitions and restoration work in the Mississippi River floodplain. Acreage of floodplain forest: 6,300, of managed swamps: 1100-2000, of riparian forests: 9,100.					
Alternative 1 **Effects on species**	**Alternative 1** **Effects on habitat indicators (in decades 2 and 10)**	**Alternatives 2 and 4** **Effects on species**	**Alternatives 2 and 4** **Effects on habitat indicators (in decades 2 and 10)**	**Alternative 3** **Effects on species**	**Alternative 3** **Effects on habitat indicators (in decades 2 and 10)**
Same as currently in natural areas. Increase in distribution and interaction of populations of some species in Mississippi River floodplain outside of natural areas, especially in long term. Adverse effects on 2 species near user-developed trails. In long term, at least 1 species in wilderness is adversely affected by lack of prescribed fire.	Generally, habitat is maintained in natural areas and improved outside natural areas in the Mississippi River floodplain. Adverse effects on habitat of 2 species near user-developed trails. In the long-term, at least 1 species' habitat in wilderness is adversely affected by lack of prescribed fire. Acreage of floodplain forest: 6,300 and 8,300, of managed swamps: 1,100 and 2000, of riparian forests: 9,100.	Same as under Alternative 1, except that more-stable populations expected with control of non-native, invasive species and increases in eco-logical disturbances, especially fire. In long term, at least 1 species in wilderness is adversely affected by lack of prescribed fire.	Same as under Alternative 1, except for improved quality and quantity in the MO management area. In the long-term, at least 1 species' habitat in wilderness is adversely affected by lack of prescribed fire. Acreage of floodplain forest in decades 2 and 10: 6,300 and 8,300, of managed swamps: 1,100-2000, of riparian forests: 9,100.	Populations of all species are declining in natural areas due to lack of vegetation treatments and limited non-native species control. Populations are increasing in MO management area in long term. In long term, at least 1 species in wilderness is adversely affected by lack of prescribed fire.	Habitat is declining in quality in short and long terms and increasing in quantity in the long term. In the long-term, at least 1 species' habitat in wilderness is adversely affected by lack of prescribed fire. Acreage of floodplain forest: 6,300 and 8,300, of managed swamps: 1,100 and 2000, of riparian forests: 9,100.

Table 3-38. Summary of effects of alternatives on RFSS plant species in cliff habitats.

Current condition of population: Populations of all species are broadly distributed but in low abundance on the Forest and in southern Illinois. Some populations of most species are interactive in areas with extensive bluff habitats. In some localized instances, populations of some species are declining due to past and present trail use. At least one species is adversely affected by dispersed recreational use at the base of the cliffs. Populations of most species are stable but not increasing.

Current condition of habitat indicators: Habitat is of good quality in most natural areas and of lesser quality outside of natural areas. Non-native invasive plant species are beginning to affect some cliff habitats with limited control to date.

Alternative 1 Effects on species	Alternative 1 Effects on habitat indicators in decades 2 and 10	Alternatives 2 and 4 Effects on species	Alternatives 2 and 4 Effects on habitat indicators in decades 2 and 10	Alternative 3 Effects on species	Alternative 3 Effects on habitat indicators in decades 2 and 10
Populations of all species are stable but not increasing in all managed cliff habitats in natural areas. At least one species continues to be adversely affected by recreational use at the base of the cliffs.	Same as current condition. At least one species' habitat will continue to be adversely affected by recreational use at the base of the cliffs.	Same as current condition, except no declines from trail use on user-developed trails. At least 1 species continues to be adversely affected by recreational use at the base of the cliffs.	Same as under Alternative 1, except quality is improved and maintained with integrated pest management, vegetation treatments and elimination of user-developed trails and use. At least 1 species' habitat continues to be adversely affected by recreational use at the base of the cliffs.	Same as current condition, except declines of some due to non-native invasive species increases. At least 1 species continues to be adversely affected by recreational use at the base of the cliffs.	Habitat is declining in quality but not quantity in the short and long terms. At least 1 species' habitat continues to be adversely effected by recreational use at the base of the cliffs.

vi. RFSS of spring and seep habitats

(*Bartonia paniculata, Isotria verticillata, Platanthera clavellata, Rudbeckia fulgida* var. *sullivantii, Sagittaria australis, Thelypteris noveboracensis*

Historically, grazing, farming, fire and fire suppression, some tree and shrub removal, road and trail development and use, and timber harvest have occurred in the vicinities of seep and spring habitats on the Forest. Most of these activities still occur and would occur on or near the Forest in the future. The largest expanses of mesic forests in southern Illinois exist on the Forest, and the most and largest populations of these plants also occur on the Forest. Considering the past, present and reasonably foreseeable future actions, both on and off the Forest, as well as the limited nature of the species' habitats on the Forest, implementation of any of the alternatives is expected to result in generally protective and beneficial, cumulative effects similar to the direct and indirect effects: the species and its habitats would be protected. Table 3-39 presents a summary of effects on RFSS plants of spring and seep habitats.

Table 3-39. Summary of effects of alternatives on RFSS plant species in spring and seep habitats.

Current condition of population: Populations of all species are restricted to remnant seep and spring communities on state and Forest land in southern Illinois. Populations are mostly distributed as patches and in low abundance. In some instances, such as in south Pope County, populations are interactive.			
Current condition of habitat indicators: Habitat is of poor quality and declining in most habitats on the Forest. It is only of good quality on state lands where management has been intense and frequent. Non-native invasive plant species are beginning to affect some habitats where no integrated control measures have been taken.			
Alternatives 1, 2 and 4 Effects on species	**Alternatives 1, 2 and 4 Effects on habitat indicators**	**Alternative 3 Effects on species**	**Alternative 3 Effects on habitat indicators**
Populations of all species are increasing in all managed seep and spring habitats in natural areas.	Habitat is increasing in quality and quantity in all seep and spring habitats managed with fire, vegetation treatments and integrated pest management.	Populations of all species are declining in the short and long terms. Some populations and species may be extirpated.	Habitat is declining in quality and quantity in the short and long terms without integrated pest management and vegetation treatments.

E. FOREST-INTERIOR HABITAT

Forest fragmentation is the breaking-up of forested areas into patches interspersed with non-forested areas. The fragmentation of forested habitat results in a reduction and patchiness of habitat and the isolation of remnant habitat-patches from each other. Research has shown that forested areas near non-forested cover are often warmer and drier, more likely to be affected by wind and more likely to be invaded by non-native species. Forest animals that live near developed areas, farmlands or roads are more likely to be affected by edge-related predation and nest-parasitism. Multiple studies by many ornithologists indicate that edge-effects (increases in nest-parasitism and predation) associated with fragmentation result in lowered nesting-success for forest-nesting songbirds.

Predators such as jays, crows, raccoons and cats, as well as the parasitic brown-headed cowbird, are usually not as abundant in extensive forests as compared to forest edges. When a forest is fragmented, predators and cowbirds gain more access to the forest and its breeding birds. The importance of large areas of contiguous forest for maintaining forest-interior bird species has been demonstrated in the eastern United States and in southern Illinois during the past 10 to 15 years (Robinson and Wilcove, 1994; Robinson *et al.*, 1995).

It is important to distinguish between a forest that is fragmented by agricultural or urban development and a forested landscape composed of a mosaic of mature and regenerating tree-stands that result from timber harvesting. The first situation typically is more damaging to forest-bird populations (Hoover 2002) since it generally represents permanent habitat loss, whereas the latter situation represents only a temporary reduction in habitat for forest-interior species that rely on mature forests (Annand and Thompson, 1997). The resulting early-successional forests also provide habitat for many bird species, including some Neotropical migrants that are declining (Thompson and Dessecker 1997). Nevertheless, forest-interior species that require mature forests are affected by both sources of fragmentation.

In most large landscapes, the needs of early-successional species can be met quickly through various sources of disturbance, including timber harvesting. However, longer time periods are required to develop suitable habitat for species that require mature forest. Effective conservation strategies must focus on maintaining adequate amounts of mature forest at all points in time. In the 1992 Plan, a conservation strategy for reducing the effects of forest fragmentation in the highest-quality habitats on the Forest was developed and implemented: forest interior management units (FIMUs) were designated to maintain habitats for songbirds and other animals that depend upon mature forest.

The FIMUs and their guidelines were developed by committees of scientists and citizens based on the data available at the time, including much local research by Dr. Scott Robinson and his associates at the University of Illinois (UI). The FIMUs were contiguous blocks of the Forest that included closed-canopy, upland-hardwood forest and were at least 750 acres. Approximately 40 percent of the FIMUs contained some pine in the overstory because of the Forest's past landscape development. At least 58 percent of the trees in each area were over 50 years old. They had been identified as essential nesting and breeding habitat for neo-tropical songbirds (e.g., scarlet tanager and Kentucky warbler) and were known to provide important habitat for other forest-interior plant and animal species.

Current research on Acadian flycatcher, a forest-interior songbird, on the west side of the Forest has resulted in some changes in earlier conclusions on habitat-size and fragmentation related to forest-interior songbirds in southern Illinois. Dr. Jeff Hoover of the Illinois Natural History Survey (Hoover, 2002) and Dr. Robinson of the University of Florida have studied forest-interior bird-nesting and cowbird-parasitism in southern Illinois since the early 1980's. Recent studies on the Forest have concluded that:

1. Increased rates of nest-predation and cowbird-parasitism are associated with "hard edges" such as row crops and pasture, and the adverse effects of hard edges on forest birds can extend more than a kilometer into the forest;

2. Areas managed under forest-interior standards and guidelines to provide "source" areas, or habitats, for these birds should be located as far as possible from hard edges;

3 Forest-interior areas should be buffered from “secondary edges” such as roads and wildlife openings by at least 400 meters.

Studies indicated that, beyond 500 meters from hard edges, some interior birds were successfully producing offspring—in general, on the east side of the Forest and at 30 to 40 percent of the number of Acadian flycatcher nests in the Camp Hutchins area, on the west side of the Forest (Hoover and Robinson, 2000; Cottam and Robinson, 2004).

Based upon this research and discussions with Hoover and Robinson, the Forest developed a management prescription based on the original FIMU concept and incorporating the conclusions of the recent local research.

FOREST-INTERIOR MANAGEMENT STANDARDS AND GUIDELINES

- All areas that are at least one mile in diameter and do not include powerlines, paved roads, levees and lakes should be considered for forest-interior management objectives.
- Forest land 400 meters from edges (paved or graveled county roads or higher-level road, levees, major powerline corridors and large reservoirs or lakes) is considered buffer area in the one-mile diameter area. Greater than 400 meters from edge is considered interior habitat. Interior habitats should be maintained along major streams or ravine bottoms where possible in each interior block.
- Forest-interior habitats should be managed for large blocks of oak-hickory forests, concentrating in historically oak areas.
- Multiple-species oak-hickory forests are featured on oak-sites, with white, red and black oaks major components of the overstory.
- Both hardwoods and pine may be included for management as interior-habitat in the interior areas.
- Burning should be conducted frequently to promote oak-hickory regeneration and control competition from shade-tolerant species.
- On ridge-tops and upper slopes, use shelterwood with reserves to help create conditions favorable for establishment of adequate oak regeneration and to maintain an open forest-canopy. On lower slopes and in ravine bottoms, thinning (commercial or non-commercial) should be done when necessary.
- Natural regeneration should be supplemented with artificial regeneration where natural regeneration is not adequate.
- Wildlife-openings should be eliminated from the interior-habitat areas within each one-mile (or greater)-diameter area.
- Openings in buffer areas should be managed to reduce parasitism and predation effects on forest-interior birds.
    - This includes fall disking or plowing and the planting of legumes and wheat cover crops, or native warm-season grasses or shrubs.
    - All mowing should occur after August 1st.

The one-mile-diameter (or-greater) area is adapted from the original FIMU prescription. Determination of the 1992 Plan’s FIMUs began with 1,100-acre circles to provide the optimum habitat: A circle has the smallest amount of edge of any shape and 1,100 acres were considered by researchers at that time to be the smallest area that could provide effective nesting-habitats minimally affected by cowbird-parasitism or predation for most interior songbirds in the eastern United States, as well as on the Forest. The effective nesting-habitat in the 1,100-acre FIMU was the 100-acre core of mature-hardwood forest. These core-areas were considered far enough away from edges to be effective nesting habitat.

The one-mile diameter area that is acceptable and preferred for interior species today is based on the earlier-discussed local research. It is drawn from this research and combined with original forest-interior management concepts to become the current forest-interior management strategy for the Forest: A one-mile diameter circular area would have a 100-acre forested core, similar to the original forest-interior concept, and a quarter-mile wide buffer-area around it. This appears to be the minimum acreage of contiguous habitat that can also provide at least 100 acres of effective nesting-habitat for forest-interior birds. It differs from the FIMU not only in its smaller size, but also in its management for the maintenance of oak-hickory forests.

These modified forest-interior management concepts and guidelines have been reviewed and discussed with Hoover and Robinson, with silviculturists on the Forest as well as silviculturists and wildlife professors and professionals from SIU and the IDNR, to determine whether the proposed management to maintain oak-hickory forest and hardwood-forest diversity could be successful silviculturally in 500-acre-or-greater areas, as well as in terms of habitat-support for the birds and other animals. The results of this review are the forest-interior management standards and guidelines cited above (2003). These new guidelines have also been incorporated into Alternatives 2 and 4.

Both the 1992 FIMU strategy and the proposed revised Plan's forest-interior management guidelines are scientific research-based management approaches to benefit some or all forest-interior songbirds and other native plants and animals dependent upon large blocks of mature hardwood forests. The key difference between the strategies is that the currently proposed one allows for the long-term management of more and diverse forests and habitat-conditions. It meets more of the habitat needs of forest songbirds as well as many other plant and animal species associated with diverse, mature-hardwood forests. The proposed strategy is expected to provide more interior-hardwood forest habitat and less forest fragmentation because it is informed by years of local research and 21st-century science.

Breeding populations of forest-interior bird species have been monitored on the Forest since the 1990's by Dr. Robinson and his associates in partnership with the Forest. Trends of this local monitoring data have been evaluated (planning record) and, along with trends in breeding-bird survey data coordinated and compiled by the USFWS for three species of interior bird species—wood thrush, Kentucky warbler and scarlet tanager—are displayed in Table 3-40.

Table 3-40. Interior-bird population trends (data collected on breeding-bird survey (BBS) routes.

Population Trend Periods Species	1970-1992 (Data from southern Illinois BBS routes)	1993-2001 (Data from southern Illinois BBS routes)	1996-2002 (Data from Central Hardwoods Bird Conservation Region BBS routes)	1970-1992 (Data from Illinois BBS routes)	1993-2001 (Data from Illinois BBS routes)
Kentucky warbler	stable	stable	stable	slight decline	increase
Scarlet tanager	increase	decrease	increase	decline	decline
Wood thrush	decline	stable	slight decline	decline	decline

Virtually no forest or openings and openland management activities have occurred in FIMUs anywhere on the Forest since 1992 (Forest Monitoring Reports 1992-2003). Local trends for forest-interior bird populations varied during this period from no-change in populations of wood thrush and Kentucky warbler to increases in populations of scarlet tanager.

Across the landscape that includes the Forest—in the Central Hardwoods Bird Conservation Region (BCR) and in the state of Illinois—population trends of these same species have varied from stable-to-increasing for the Kentucky warbler to declining for the wood thrush and declining in Illinois for the scarlet tanager, but increasing at the regional level.

It is difficult from these data to determine whether the original FIMUs have been effective in improving conditions for the majority of forest-interior birds on the Forest since 1992. Additional factors in this evaluation are the surrounding and interspersed private land uses that can affect indirectly and adversely many habitats on the Forest and, so, affect populations of interior-bird species in southern Illinois, as well as the possible adverse effects on the birds' wintering habitats in Central and South American countries.

DIRECT AND INDIRECT EFFECTS ON FOREST-INTERIOR HABITAT

The direct, indirect and cumulative effects of the alternatives on the wood thrush, worm-eating warbler and scarlet tanager, three MIS and forest-interior bird species, are discussed in Part Two of the preceding Biodiversity section, at number 1 under "Species Viability." The direct, indirect and cumulative effects of the alternatives on the cerulean warbler, a RFSS and forest-interior bird, are discussed in Part Two of the preceding Biodiversity section, at number 4 under "Species Viability."

Under any of the alternatives, forest-interior habitats and associated CR, WD, NM (CH and RW), WW and CV management areas and riparian filter strips would provide forested corridors for animal and plant movement across the Forest and across southern Illinois. The more acreage of forest-interior habitat provided under an alternative, the more that alternative would benefit biological corridors for the native plants and animals of southern Illinois. Table 3-41 presents relative areas of forest-interior habitat by alternative.

Table 3-41. Forest-interior habitats by alternative based upon GIS analysis.

Acres	Alternative1	Alternatives 2 and 4	Alternative 3
Total directly managed as forest interior	7,600 acres (6.4 management area only)	56,290 acres (EH and MH management areas only)	56,290 acres (MH management areas)
Total core areas within managed forest-interior areas	700 acres (6.4 management area only)	9,388 acres (EH and MH management areas only)	9,388 acres (in MH management areas only)
Total core areas greater than 400 meters from hard edges	35,248 acres (greater than 400 meters from hard edges in all management areas)	35,248 acres (greater than 400 meters from hard edges in all management areas)	35,248 acres (greater than 400 meters from hard edges in all management areas)
Total *de facto* Forest Interior areas	67,700 acres (in WD, CV, CR, HR, NA, CH, RW and RA other than Dixon Springs)	43,115 acres (1/2-mile radius areas free of hard edges in management areas CR, CV, HR, MM, NA, NM and WD that indirectly provide habitat for interior species)	43,115 acres (same as Alternative 2)
Total area managed directly and indirectly to benefit Forest-interior species	75,300 acres	99,400 acres	99,400 acres

Each of the alternatives would provide some amount of relatively unfragmented, mature-hardwood forests. Some would provide more than others and some of the forest-interior habitat provided in some would not be as diverse as others. The species- and structural-diversity of the unfragmented forest areas would also have effects on some forest-interior bird species and will be evaluated along with the total acreage of unfragmented forest. Species such as the wood thrush, a noted forest-interior species, may depend upon early-successional forest areas in close proximity to mature forests for brood survival (Anders *et al*., 1998).

Thompson *et al.* (1992) found that the worm-eating, Kentucky and black and white warblers—all forest-interior species—reached their highest abundance in hardwoods with a mixture of successional stages, including early-successional forest in close proximity to pole and mature forest. Anders *et al.* (1998) suggest that in large tracts of mature deciduous-forest, a mosaic of early and mid-successional forest stands, along with mature riparian-forest, will accommodate both the breeding and post-dispersal habitat requirements of the wood thrush and other Neotropical migrants.

Maintaining a diversity of forest-types and size-classes of trees, including oak-types that are dependent upon disturbance for regeneration, is important for forest-interior species, if not in the short term then in the long. All alternatives would maintain some level of forest-interior species diversity.

1. Restrictive Management

a. Alternative 1

Alternative 1 provides seven, 1,100-acre units—FIMUs—managed with no vegetation-disturbance. These areas are dominated by mature (over 50 years old) upland hardwoods and—together with wilderness areas, the Cave Valley management area, Camp Hutchins and Ripple Hollow management areas and candidate wild and scenic river corridors—are intended to provide, directly or indirectly, about 75,300 acres of relatively large blocks of mature and old-growth hardwood forest habitats. No vegetation management other than small amounts of burning in natural-area inclusions would be allowed in these areas. They would provide relatively large blocks of old-growth hardwood forest that would indirectly benefit forest birds dependent upon large blocks of unfragmented hardwood forests. In the short term (20 years) they still would be dominated by oak species; however, in the long term (100 years and longer), with no management, they would be dominated by maple and beech species and contain no early-successional hardwood forest habitats.

b. Alternatives 2 and 4

Along with the acres under even-aged and mature-hardwood forest management, wilderness areas, the Cave Valley management area, candidate wild and scenic river corridors, non-motorized recreational areas and about 6,000 acres of interior habitat in four natural areas—Pine Hills, Bell Smith Springs, Atwood Ridge and Little Grand Canyon—this alternative would provide about 99,400 acres of interior habitat (34 percent of the Forest) dominated by mature forest in 500-acre blocks or larger. This interior-habitat acreage would be managed to reduce forest fragmentation and about 41,500 acres of that would be managed to provide for long-term forest-diversity.

c. Alternative 3

Most of the Forest—232,300 acres, or about 82 percent—would be managed restrictively, resulting in indirect and beneficial effects on most forest-interior species. Prescribed fire and vegetation management would occur only in natural areas. This alternative would include interior core-areas and acreage equivalent to that under Alternatives 2 and 4. Even though more area would be managed restrictively, the number of blocks of interior habitat greater than 500 acres would not increase due to the fragmentation of land ownership within the Forest proclamation boundary. In the short term, this alternative would provide interior habitat equivalent to Alternatives 2 and 4, with comparable beneficial effects for interior species.

2. Roads and Trails Management

No effects are anticipated.

3. Recreational Use of Trails and Roads

No measurable effects are anticipated.

4. Dispersed Recreational Use

No effects are anticipated.

5. Developed Recreational Site Use

No effects are anticipated.

6. Timber Harvest

a. Alternative 1

Timber harvest in uneven-aged hardwood management areas would be by group-selection in mature hardwood forests, with the groups generally less than six-tenths of an acre and some individual-tree harvest of at-risk trees between the groups (improvement cutting). Timber harvest could also involve shelterwood harvest in some mature pine plantations, mostly in uneven-aged hardwood and mature-hardwood forest management areas. Shelterwood harvest of pines in these management areas would be done to release and re-establish native hardwoods as part of ecological restoration.

Uneven-aged management practices would provide a variety of forest-successional stages and provide for some long-term forest diversity. However, there would be no unmanaged core-areas and, so, these management areas would provide only limited habitat for some interior songbird species, such as the hooded warbler and parula warbler. Shelterwood harvest of pines in uneven-aged hardwood or mature hardwood forest management areas would also provide early-successional hardwood-forest areas and, in turn, some diversity of forest habitats. However, no interior core-areas would be provided near or adjacent to early-successional forest and, thus, there would be only limited benefits to interior-bird species from this additional forest diversity.

b. Alternatives 2 and 4

Alternatives 2 and 4 would apply forest-interior management guidelines—as described above—to even-aged hardwood and mature-hardwood forest management areas, providing about 56,300 acres of diverse, forest-interior habitats. Some managed and unmanaged pine plantations would be included in these areas. Management could include prescribed fire throughout; timber harvest primarily on ridge-tops and upper slopes, utilizing shelterwood with reserves; and some vegetation management. These actions would be done to maintain or restore (in pine plantations) some oak-hickory-dominated hardwood forests in interior habitats and more, long-term, overall biodiversity in these interior forests (Thompson *et al.*, 1992; Anders *et al.*, 1998).

c. Alternative 3

Timber harvest would not occur. No effects are anticipated.

7. Vegetation Treatments

a. Alternatives 1, 2 and 4

About 6,000 acres of mature-hardwood-dominated interior habitat in the Pine Hills, Bell Smith Springs, Atwood Ridge and Little Grand Canyon natural areas would receive some vegetation management, primarily prescribed fire and selective thinnings. In the short term (10 to 15 years) and long term (50 years and longer), they would remain dominated by oak species. Thus they would also provide habitat for birds and other animals and plants dependent upon large blocks of relatively unfragmented, hardwood forests. They may also contain a few small patches of early-successional hardwood-forest habitats associated with some selective tree thinnings.

b. Alternative 3

No effects are anticipated due to the minimum level of vegetation treatment allowed under this alternative.

8. Fire Management

a. Alternative 1

Under Alternative 1 fire management in existing FIMUs would have minimal effect on interior habitats because so few acres of interior habitats would be affected.

b. Alternatives 2 and 4

Under Alternatives 2 and 4, fire management that would include prescribed fire of about 50 percent of the large blocks of forest—about 67,000 acres—to maintain oak-hickory forest diversity would affect overstory densities, generally lessening them on ridge-tops and upper slopes and creating more-open canopy conditions in these areas. About 50 percent of the existing forest-interior habitats would not be affected by fire.

Understories in burned areas of interior forest would include more herbaceous plants. Canopies and understories on lower slopes and bottoms in burned areas of interior forest would not be measurably affected, as fire and timber management combined would be much less intense in these areas, the latter due to topography and soil-moisture conditions. Understories—especially on upper slopes and ridgetops in interior areas—would be modified by prescribed fire with a reduction in shrubs and small trees and increases in herbaceous cover in most treated areas.

As a result of burning under this alternative, interior forests would have more diversity of vegetation and wildlife in both the short and long term than under Alternative 1. There would be some adverse effects on nesting habitat for some interior bird species in the short term, such as the wood thrush and worm-eating warbler, that nest in shrubs and small trees and on the forest floor but, conversely, there would also be an improvement in brood and foraging habitats for some of these same species (Anders *et al.*, 1998) as understory densities become more diverse following fire-application, especially on ridgetops and upper slopes.

c. Alternative 3

Fire management under this alternative would have no direct effects since little if any fire would occur in forest-interior areas. Indirectly and in the long term, interior areas would be less diverse in both the overstories and understories due to lack of burning.

9. Integrated Pest Management

No effects are anticipated under any alternative.

10. Openings and Openlands Management

a. Alternatives 1 and 4

Openings and openlands management could occur outside FIMUs in limited locations near the edges, but would be limited in candidate wild and scenic river corridors. This openings-management strategy would indirectly and beneficially affect forest-interior species within the FIMUs by reducing forest fragmentation. The strategy would have no effect, or limited beneficial effects, on forest-interior species in other management areas because they provide marginal habitats for these species.

b. Alternative 2

Openings and openlands management would involve fewer acres than under Alternative 1, reducing non-forested land uses that could fragment large blocks of mature-hardwood forest. Also, the remaining wildlife openings in even-aged hardwood and mature-hardwood forest management areas over 500 acres in size would be managed to reduce cowbird feeding-habitats and nest-parasitism. The net effect of less openings management and less cowbird-parasitism under this alternative should be greater, indirect and more beneficial on forest-interior bird populations than under Alternative 1.

c. Alternative 3

Openings and openlands management would not be allowed. The resulting elimination of wildlife openings and reduction of forest edges would reduce the effects of nest-parasitism and some predation-effects on interior species.

11. Aquatic Resources Management

No effects are anticipated under any alternative.

12. Minerals Management

a. Alternative 1

Minerals management under Alternative 1 would be allowed in some of the interior habitats. Most would involve special stipulations to lessen or eliminate fragmenting activities. Management of privately owned minerals could have some fragmenting effects as small sites are cleared of forest and minerals are developed. These would in turn cause minor, adverse effects on forest-interior species in forest-interior management areas. Actions to develop private minerals on the Forest have been very limited in scope and the trend over the next 10 to 15 years should be similar. Therefore, any adverse indirect effects from this management activity are expected to be minimal.

Management of federal minerals under Alternative 1 could result in some adverse, primarily indirect effects on migratory birds from mineral-leasing actions, due to the fragmentation that could be caused by opening the canopy in some forest-interior areas for drilling and production facilities. These effects would not be widespread across the Forest, but localized in the more mineral-rich areas. However, any new mineral lease of federally owned minerals, or proposal for oil and gas exploration and development, would be subject to site-specific environmental analysis, during which some of the effects on migratory birds could be mitigated by limiting the size and locations of any facilities.

No development of federally owned minerals is allowed in the WD management areas. These areas include the largest, relatively unfragmented forested areas on the Forest and provide over 28,000 acres of habitat for many forest-interior species that would remain unaffected by minerals-management actions. Surface occupancy for minerals management is not allowed under the CV, DR, HR, NA and CR management areas (52,000 acres) or within riparian areas and filter strips (approximately 20,000 acres) Forest-wide. This would prevent the possible, adverse effects of mineral leasing and extraction on migratory birds in those areas. All the habitats, including forest-interior management areas within the MH and MO management areas (33,500 acres), have a limitation on surface use for the protection of migratory birds from April 1 to July 15. This would limit noise and vegetation-management disturbances and their direct and indirect effects on nesting, migratory birds in these areas.

Anticipating compliance with Plan standards and guidelines and limited and localized minerals management on the Forest, it is expected that federal mineral-leasing and extractions would have only minimally adverse effects on migratory birds, including many forest-interior species, and have few overall effects on populations of migratory birds on the Forest.

b. Alternatives 2 and 4

Effects of minerals management on forest interior species and their habitats would be comparable to those under Alternative 1. Only small amounts of private mineral developments and associated fragmenting actions are expected to occur under this alternative and these would be in the even-aged hardwood, mature hardwood or non-motorized management areas. Thus, effects are expected to be minimal, adverse and indirect on forest-interior species and their habitats.

Sites proposed for the exploration and development of oil/gas resources would be subject to site-specific analysis of the proposed activities. Disclosure of the expected, project-related effects on forest-interior habitat and species would be part of this analysis.

c. Alternative 3

Effects of minerals management on forest-interior species and their habitats would be comparable to those under Alternative 1, except that there would be no management or development of federally owned minerals. Only small amounts of private mineral developments and associated fragmenting actions are expected to occur under this alternative and these would be in the even-aged hardwood, mature hardwood or non-motorized management areas. Thus, effects are expected to minimal, adverse and indirect on forest-interior species and their habitats.

13. Land-Ownership Adjustment

All Alternatives

The primary objective of most land-ownership adjustments is to provide the optimum land-ownership pattern by consolidating ownership and, subsequently, management efficiency. This would support protection of sensitive resources and species, improve public access and enhance public satisfaction. The effects of land-ownership adjustment on forest-interior habitat are directly related to the amount of acquisition and exchange that takes place and the condition of the habitat on the acquired and exchanged lands. Because the alternatives do not dictate a schedule for acquisition or exchange and no specific effects can be anticipated programmatically, this activity has had and should continue to have substantial, indirect and beneficial effects on interior habitats by reducing fragmentation of the Forest.

CUMULATIVE EFFECTS ON FOREST-INTERIOR HABITAT

This discussion of cumulative effects takes into consideration the past, present and reasonably foreseeable future actions specified at the beginning of Chapter 3. Beyond the scope of this analysis are the migration-route and winter habitats of the many forest-interior species—mainly migratory songbirds—some of which are in Central and South America. Although these habitats are beyond the scope of this analysis, actions that affect them contribute to the cumulative effects on the species.

1. Alternative 1

Interior habitats could be improved or maintained on about 75,300 acres (Table 3-40). Management of other areas should have no effect or slight positive effects on interior habitats as forest-diversity is improved. However, populations of most interior species may not improve in the planning area due to the fragmentation of land uses and management on adjacent privately owned lands and the remote, adverse effects on wintering habitats in Central and South American countries.

2. Alternatives 2 and 4

Interior habitats could be improved or maintained on about 99,400 acres (Table 3-40). These habitats would include the largest possible amounts of core, unfragmented, interior-forest acreage. Management of other areas should have no effect or moderate positive effects on interior habitats as forest diversity is improved. These two alternatives would also provide the most forest-diversity for those interior species dependent upon mixtures of successional stages of hardwood forests and habitats for optimum habitat quality and use. However, populations of most interior species may not improve substantially in the planning area due to the fragmentation of land uses and farming and grazing management on adjacent privately owned lands and the remote, adverse effects, especially of deforestation, on wintering habitats in Central and South American countries.

Alternative 2 would provide more unfragmented, high-quality, forest-interior and core-area habitats for forest-interior birds and other plants and animals dependent upon mature hardwood forests than would Alternative 1. This management would have beneficial effects on forest-interior species and their habitats.

Alternative 4 would affect forest-interior species and habitats in about the same manner as Alternative 2 except that, since the openings and openlands acreage would be comparable to Alternative 1, it would have greater adverse effects on interior habitats than those identified under Alternative 2.

3. Alternative 3

Mature hardwood forest habitats would be prevalent on approximately 232,000 acres of the Forest. Effective interior habitats (blocks of hardwood forest 500 acres or larger) would be maintained and/or improved on about 99,400 acres (Table 3-40). Non-forested land uses, such as wildlife openings and large openlands and oldfields, would be eliminated. This could have minor, beneficial, cumulative effects on forest-interior habitats by reducing forest fragmentation. Management of other areas should have no effect or slightly beneficial, cumulative effects as forest diversity is improved. Alternative 3 would provide the least forest diversity for interior species dependent upon mixtures of forest successional-stages.

Even with large acreages of mature and old-growth forest expected in the future under Alternative 3, populations of most interior species might not improve substantially in the planning area due to the fragmentation of land uses and management on adjacent privately owned lands (farming and grazing) and the remote, adverse effects on wintering habitats (from deforestation) in Central and South American countries.

Alternative 3 would not provide for forest diversity or maintain it in the future. Lack of disturbances and other successional stages of hardwood forest would limit forest diversity and result in effects for some interior bird species that would not be as beneficial as Alternative 2. For those interior bird species, such as the wood thrush, that also need some of the other successional stages of hardwood forest for parts of their life-cycle, this would not be as beneficial as Alternative 2.

F. NATURAL AREAS

The Forest recognizes the value of unique biological and geological features and has designated 80 “natural areas” that are managed to ensure that the biotic diversity of the natural communities within them is maintained and/or enhanced. Natural area management is specified in the proposed Plan under the Natural Area Management Prescription and in Appendix D. The management prescription is intended to preserve, protect and enhance each area’s unique scientific, educational or natural intrinsic values. Natural areas include all research natural areas, sites listed on the national register of national natural landmarks, geological areas, zoological areas, ecological areas and botanical areas. Table 3-42 provides a list of all natural areas on the Forest.

Forest Supervisors have signed closure orders for the protection of the natural areas. These orders prohibit certain activities, such as fire use (except for gas-stoves), rappelling or rock-climbing, off-highway vehicle use, equestrian-use and camping at unapproved sites. The Forest maintains on-the-ground marking of natural-area boundaries to ensure that the significant and exceptional features for which the areas are designated are bounded and protected.

Table 3-42. Natural areas of the Forest: Research natural area (RNA), ecological area (EA), botanical area (BA), geological area (GA), zoological area (ZA), national natural landmark (NNL)

Hidden Springs Ranger District	
Barker Bluff RNA EA	Bell Smith Springs EA
Big Creek ZA (CR inclusion*)	Brown's Hole ZA
Bulge Hole EA	Burke Branch RNA EA
Cane Creek RNA	Caney Branch Barrens EA (WD inclusion)
Cave Hill RNA EA	Chimaphila Site BA (WD inclusion)
Copperous Branch Limestone Barrens EA	Cretaceous Hills EA
Crow Knob EA	Dean Cemetery East Barrens EA
Dean Cemetery West Barrens EA	Dennison Hollow RNA EA
Dog Barrens EA	Double Branch Hole EA
East Fork *Oxalis Illinoensis* BA (WD inclusion*)	Fink Sandstone Barrens EA
Garden of the Gods EA (WD inclusion*)	Gibbons Creek EA
Grantsburg Swamp EA	Gyp Williams Hollow EA
Hayes Creek-Fox Den Creek EA	Jackson Hole EA
Jackson Hollow EA	Kaskaskia Woods EA (RA inclusion)
Keeling Hill North EA	Keeling Hill South EA
Kickasola Cemetery EA	Leisure City Limestone Barrens (CR inclusion)
Lusk Creek Canyon EA (WD inclusion*)	Lusk Creek North EA (WD inclusion)
Lusk Creek ZA (WD inclusion*)	Martha's Woods EA (WD inclusion)
Massac Tower Springs EA	Millstone Bluff EA (HR inclusion)
Odum Tract EA	Panther Hollow RNA EA
Pine Hollow EA	Pleasant Valley Barrens EA
Poco Cemetery East EA	Poco Cemetery North EA
Pounds Hollow EA	Reddick Hollow BA (CR inclusion)
Reid's Chapel EA	Robnett Barrens EA
Russell Cemetery Barrens EA	Sand EA
Schwegman EA	Simpson Township Barrens EA
Snow Spring EA	Split Rock Hollow EA
Stoneface RNA EA	Sulphur Springs Area BA
Teal Pond BA	Whoopie Cat RNA EA
Mississippi Bluffs Ranger District	
Atwood Ridge RNA EA	Ava ZA
Bald Knob GA (WD inclusion*)	Bear Creek Relict Site BA
Big Brushy Ridge EA	Clear Creek Swamp BA
Clear Springs ZA	Dutch Creek Chert Woodland EA
Fountain Bluff GA (HR inclusion*)	Greentree Reservoir BA
Hutchison ZA (WD inclusion*)	LaRue-Pine Hills/Otter Pond RNA EA (WD inclusion)
Little Grand Canyon-Horseshoe Bluff EA	Opossum Trot Trail BA
Ozark Hill Prairie RNA EA	Pine Hills Annex EA (WD inclusion)
Provo Cemetery EA	Rich's ZA
Saltpeter Relict BA	Silvey Pond BA
Toothless ZA	Wolf Creek BA

Research natural areas are set aside for non-manipulative research, observation and study. Each area is part of a national network representing the gamut of North American ecosystems, biological communities, habitats, phenomena and geological and hydrological formations and conditions. The ten research natural areas on the Forest were established by the Chief of the Forest Service: Dennison Hollow, Panther Hollow, Stoneface, Cave Hill, Atwood Ridge, Barker Bluff, Whoopie Cat Mountain, Burke Branch, Ozark Hill Prairie and LaRue Pine Hills–Otter Pond. The analysis regarding research natural areas required by the planning regulations at 36 CFR 219-25 is documented in Appendix D.

EFFECTS ON NATURAL AREAS

The spatial boundaries of this analysis include the watersheds in which the natural areas are located.

Management of natural areas can be classified as passive or active. Passive management allows the ecological process of secondary succession to proceed and can result in the degradation and/or extirpation of disturbance-adapted communities (disclimax communities). For example, invasion of a plant community by the exotic species Japanese honeysuckle (*Lonicera japonica*) would result in a decrease in species diversity, frequency and abundance and could allow other species to invade the community and alter its composition. Active management through the application of prescriptions contained in Appendix D of the proposed Plan allows for the restoration, maintenance and enhancement of these natural communities.

1. Restrictive Management

Natural areas are managed restrictively under all alternatives. Beneficial, direct and indirect effects are expected from this management as well as from all other restrictive management activities.

2. Roads and Trails Management

a. Alternatives 1, 2 and 4

Since all three alternatives allow the consideration of equestrian trails in natural areas, each could have minimal, adverse, direct and indirect effects associated with trail construction in the short term. Although trail-construction would require the removal of vegetation along a corridor, natural area management and adequate trail maintenance would prevent community fragmentation and the potential for unauthorized off-trail activities.

b. Alternative 3

Alternative 3 would allow no trails in natural areas. With the exception of the natural areas with hiker trails, including Garden of the Gods, Pounds Hollow, Little Grand Canyon and Bell Smith Springs, most should incur no adverse, direct or indirect effects.

3. Recreational Use of Trails and Roads

a. Alternatives 1, 2 and 4

Alternatives 1, 2 and 4 could have minor, adverse, direct and indirect effects on natural areas. Trail use could lead to the introduction of non-native invasive species as well as to unauthorized, off-trail use that could damage sensitive plants or their habitat.

b. Alternative 3

Alternative 3 would allow only hiker trails in natural areas. With the exception of the natural areas with hiker trails, most should incur no adverse, direct or indirect effects from this alternative.

4. Dispersed Recreational Use

Dispersed recreational activities, which do not include equestrian use in natural areas under any alternative, are expected to have minimal to no adverse, direct and indirect effects on natural areas. Although trail use under Alterntives 1, 2 and 4 has the possibility of enabling unauthorized off-trail activities, natural area management and monitoring would prevent community fragmentation and the potential for unauthorized activities.

5. Developed Recreational Site Use

Developed recreational sites are found in or adjacent to natural areas such as LaRue-Pine Hills/Otter Pond, Little Grand Canyon, Bell Smith Springs and Garden of the Gods. These areas are co-managed under all alternatives so that any effects on the natural areas are minimized and confined. These areas are monitored regularly and diligently maintained. No adverse effects on natural areas are anticipated from the continued use of the developed recreational sites.

6. Timber Harvest

With no commercial timber harvest allowed in natural areas under any alternative, no effects are anticipated.

7. Vegetation Treatments

a. Alternatives 1, 2 and 4

Alternatives 1, 2 and 4 allow assertive treatments such as tree-cutting, prescribed fire, herbicide-use and mowing. All of these would encourage native species through enhancement of their habitats. The unique community-types protected in natural areas would benefit both directly and indirectly, in the short and long term, by implementation of these treatment methods.

b. Alternative 3

Alternative 3 would be the same as Alternatives 1, 2 and 4 except that there would be no use of pesticides.

8. Fire Management

a. Alternatives 1, 2 and 4

The prescribed fire proposed under Alternatives 1, 2 and 4 would have beneficial, direct and indirect effects on natural areas in both the short and long terms. Such burning would enable research natural areas to successfully resist succession to more aggressive native and non-native species and non-desirable community-types. Without such burning, unique, rare and native communities protected in the natural areas would be threatened by succession to more mesic, monotypic communities. (Examples of this are sugar maple-dominated woodlands and forests and Japanese honeysuckle-dominated herbaceous layers.)

b. Alternative 3

Alternative 3 would result in adverse, direct and indirect effects on these areas because limited prescribed fire would allow natural areas to succeed to more aggressive native and non-native species and non-desirable community-types. Additionally, unique, rare and native communities would be threatened by succession to more mesic monotypic communities. (Examples of this are sugar maple-dominated woodlands and forests and Japanese honeysuckle-dominated herbaceous layers.)

9. Integrated Pest Management

a. Alternatives 1, 2 and 4

Alternatives 1, 2 and 4 allow for an aggressive approach to integrated pest management; these alternatives also allow consideration of hiker-equestrian trails that could function as corridors for invasive species. Monitoring and management would protect and, possibly, enhance the affected natural communities,resulting in beneficial, direct and indirect effects. Any of these alternatives has the potential for more beneficial, indirect effects on the natural area communities than Alternative 3 because of the tools available to fight non-native invasive species.

b. Alternative 3

Alternative 3 discourages trails in natural areas, eliminating most of the trail-corridor effects; but, at the same time, it restricts pesticide-use. This alternative also limits prescribed fire, which aids in the control and/or elimination of several invasive species. This alternative has the potential for more adverse, indirect effects on the natural area communities than Alternatives 1, 2 and 4 because of the restrictions imposed in the fight against non-native invasive species.

10. Openings and Openlands Management

Under all alternatives, openings and openlands are not allowed in natural areas; therefore, no effects are anticipated.

11. Aquatic Resources Management

Under all alternatives, the areas that could be affected are the Big Creek and Lusk Creek Zoological Areas. However, since aquatic-resources management activities would only be carried out to promote or maintain the features of these streams, no effects are anticipated.

12. Minerals Management

a. Alternative 1

This alternative allows surface-occupancy within natural areas, but only with special stipulations. A no-surface-occupancy special stipulation would be utilized in those areas where occupancy could have adverse effects on the special feature(s) for which the area was established.

b. Alternatives 2, 3 and 4

These alternatives do not allow surface occupancy in natural areas; therefore, no effects are anticipated.

13. Land-Ownership Adjustment

The primary objective of most land-ownership adjustments is to provide the optimum land-ownership pattern by consolidating ownership and, subsequently, management efficiency. The effects of land-ownership adjustment on natural areas are directly related to the amount of acquisition and exchange that takes place and the condition of the forest and timber resource on the acquired and exchanged lands. Under any of the alternatives, natural areas are unavailable for exchange or disposal unless resource protection is guaranteed. Because the alternatives do not dictate a schedule for acquisition or exchange, no effects can be anticipated programmatically.

CUMULATIVE EFFECTS ON NATURAL AREAS

This discussion of cumulative effects takes into consideration the past, present and reasonably foreseeable future actions specified at the beginning of Chapter 3. Generally speaking, past, present and reasonably foreseeable future actions on privately owned land have had, do have and are expected to have minimal effects on natural areas. Only the development of equestrian campgrounds on privately owned land near the Forest has specifically had effects on some of these areas. Accordingly, the cumulative effects discussed here generally are related to Forest management and use activities.

The development of equestrian campgrounds on privately owned land near the Forest has resulted in increased equestrian use of natural areas in the past decade. The total number of horseback-riders from existing equestrian campgrounds is expected to remain the same or increase in the foreseeable future, especially for visitors from out of state. However, the number of privately owned equestrian campgrounds is not expected to increase significantly.

All Alternatives

Considering past, present and reasonably foreseeable future actions and the effects on natural areas, both on and near the Forest, implementation of any of the alternatives would result in minimally adverse to beneficial cumulative effects. The value of the natural areas would be maintained.

G. CANDIDATE WILD AND SCENIC RIVERS

Six streams on the Forest are identified in the Plan as eligible for inclusion in the national wild and scenic rivers system: Bay Creek, Big Creek, Big Grand Pierre Creek, Hutchins Creek, Lusk Creek and the Big Muddy River. The plan-revision interdisciplinary team—as directed by Forest Service guidance—determined interim classifications for the management of the six streams.

In addition, a Forest-wide analysis was conducted to identify additional rivers for outstanding remarkable values and potential eligibility for inclusion into the national system. Twenty-three other streams were considered by the interdisciplinary team and evaluated for possible inclusion into the wild and scenic rivers system. None met the conditions that require a free-flowing nature, the presence of one outstandingly remarkable value, or that protection or enhancement would not be provided through current management practices for riparian areas. A wild and scenic river classification and eligibility report (2003) was prepared on November 25, 2003. Table 3-43 summarizes the mileage for each stream and its interim classification.

Table 3-43. Candidate wild and scenic rivers, with mileage and interim classification.

Stream	Total Miles within Forest Boundary	National Forest Stream-Miles outside Wilderness	Interim Classification
Bay Creek	30.8	11.4 (2.2 in WD)	Recreational
Big Creek	17	8.8	Recreational
Big Grand Pierre Creek	19.2	7.4	Recreational
Big Muddy River	21.3	16.1	Recreational
Hutchins Creek	13	1.3 (3.5 in WD)	Recreational
Lusk Creek	30.2	3.9/5 (6.2 in WD)	Scenic/Recreational

The interim classifications apply only to national forest stream-miles and lands within one-quarter mile on either side. Fragmented ownership patterns along each stream prevent contiguous management prescriptions; rarely is Forest ownership longer than a continuous mile. Detailed descriptions of the outstanding remarkable values, corridor acreages, road mileages and trail mileages are included in the eligibility report in Appendix C.

ALL EFFECTS ON CANDIDATE WILD AND SCENIC RIVERS

The spatial boundary of this effects analysis is the watershed within which each of the candidate wild and scenic rivers occurs. None of the management activities proposed under any alternative is anticipated to have any adverse effect on the attributes of the candidate wild and scenic rivers. Considering the past, present and reasonably foreseeable future actions and effects on candidate wild and scenic rivers, both on and near the Forest, implementation of any alternative would result cumulatively in the protection of the potential classification of each candidate waterway.

H. WILDERNESS

The Illinois Wilderness Act of 1990 designated seven areas of the Forest as units of the National Wilderness Preservation System. These areas were set aside as wilderness to preserve natural features, including native prairies and savannahs, old-growth hardwood forests, deep ravines, limestone bluffs, waterfalls, sandstone cliffs and shelter caves (H.R. 5428, 1990). In addition, wilderness offers non-motorized recreational opportunities, a rare commodity in most public lands in Illinois. Table 3-44 displays the details of the wilderness areas. In November of 1998, two special-management areas—Eagle Creek and East Fork—were included into the Garden of the Gods and Lusk Creek Wilderness Areas, respectively.

1. RECREATION OPPORTUNITY SPECTRUM (ROS)

Each wilderness is unique in scenery and opportunity for primitive recreation and solitude. Each wilderness is managed, in part, for a semi-primitive, non-motorized, recreational experience within the ROS system. However, some aspects of the semi-primitive, non-motorized criteria and management are not met. Core areas one-half mile from a road should be 2,500 acres to meet remoteness and size criteria. In addition, management is inconsistent with semi-primitive, non-motorized in the use of frequently placed carsonite posts and painted blazes. The ROS guideline requires on-site management-controls to be present, but subtle (USDA FS, 1982). Wilderness encourages the use of native materials and unobtrusive management. In addition, the numbers of encounters with other recreational users may be higher than 6 to 15 parties per day on heavy-visitation days in Lusk Creek and Garden of the Gods Wildernesses, and occasionally in large groups.

2. TRAILS AND TRAIL FACILITIES

There are 50 miles of system trail in five of the seven wildernesses. There are approximately 90 miles of non-system trail recorded in all seven wildernesses. Since the 1992 Plan, many of the system trails have become popular and receive heavy equestrian use, particularly in Lusk Creek. This increased use has deteriorated the condition of many miles of system trail. They are wider, muddier, braided, compacted and gullied and, therefore, affecting the natural condition and possibly the ecological, or scenic, or other features within wilderness. In order to respond to increased use, hardening with gravel and adding water-diversion dips and water bars has been done to improve the trail experience.

Of the 50 miles of system trails in wilderness, about 38 miles (75 percent) of hiker-equestrian require reconstruction to meet several national trail standards. The 38 miles of trails in need of reconstruction are in disrepair. Trail guidelines for wilderness system trails designated for hiker and/or equestrian use should meet trail standards identified in the Forest Service Handbook and related guidance (USDA FS, 2005).

Table 3-44. Wilderness acreage, trail miles and trail density.

Wilderness	Acres	Square Miles	System trails	System-Trail Density	Old Travelways + User-Developed Trails*	System Trails + Non-system trails*	Trail Density of ALL routes (System + Non-system)
Garden of the Gods	3,996	6.24	13.17	2.11	4.6	17.77	2.85
Lusk Creek	6,298	9.84	10.16	1.03	44.3	54.46	5.53
Bay Creek	2,769	4.33	0	0	11.1	11.1	2.56
Burden Falls	3,687	5.76	1.08*	0.19	16.92	18	3.13
Panther Den*	839	1.31	4.2*	3.21	0.54	4.74	3.62
Clear Springs	4,769	7.45	9.6*	1.29	9.23	20.84	2.8
Bald Knob	5,786	9.04	11.61*	1.28	4.79	14.39	1.59
Total	28,144	44	49.82	1.13	91.48	141.3	3.21
*Panther Den (FS) + Crab Orchard (FWS) Wilderness	4,889	7.64	9.2	1.2	7	16.74	2.19

* Combined acreages and mileages. Crab Orchard Wilderness trail mileages are estimates.

All wilderness trails require annual maintenance. At present, budget levels fall considerably below the funding needed to provide adequate annual maintenance and adequate reconstruction on high-use hiker-equestrian, wilderness system trails. Other funding means, such as partnerships, volunteers, grants, trail adoption programs, and others will likely be needed to achieve an adequate level of protection and visitor service in wilderness.

One permanent and eight temporary confinement areas have been erected for equestrians that gather at notable attractions, in an effort to prevent tree mortality and vegetation trampling, and to minimize the area of soil compaction. While these areas provide a service to horseback riders and resource protection, permanent hitching racks are prohibited in the proposed Plan standards and guidelines.

3. TRAIL DENSITY

In the 1992 Plan, wilderness system-trail density is specified at one mile per square mile and has been calculated by summing all the system-trail miles in wilderness (about 50) and dividing by the total number of square miles of wilderness (about 44) throughout the Forest. With 50 miles of system trails in wilderness, the average trail-density is about one mile per square mile. With the Plan standard met, no additional system trails can be constructed in wilderness without eliminating existing system trails. There currently are more miles of trail in some wilderness areas than in others, and the trail-densities vary among the wilderness areas because of the differences in the acreage of each.

System-trail densities were established in the Forest Plan because they were perceived to be an indicator of a quality wilderness experience, or opportunity for solitude: the lower the trail-density, the higher the opportunity for solitude. However, in practice, system-trail density-standards are not a good indicator of the opportunity for solitude. They are not commonly established in wildernesses in the eastern United States. Density standards do not control the amount of use, the size of groups encountered, the seasons of use, the influence of audible motorized noise, or the evidence of human-caused damage.

Other factors have been found to have a greater influence on the opportunity for solitude, such as the proper location of trails, utilization of bluffs, hills and vegetation to separate trails, the encouragement of one-way travel on loop trails and the use of trails on weekdays or during other, lower-use periods. Limiting the miles of trail or total numbers of users in wilderness, for example, would have a greater effect on the opportunities for solitude than would trail density. Wilderness literature supports several other management practices and conditions to measure opportunities for solitude, or to address the ecological and social carrying-capacities in wilderness (Lucas, 1990; Stankey and McCool, 1990; Hendee, *et al.*, 1978). Numbers of encounters with other visitors and measuring visitor satisfaction with their experience of solitude are factors that can be used to measure opportunities for solitude. The visible effects of resource damage from recreational use, the use of non-native materials in signs, and other obvious effects of management also influence the natural condition in wilderness and the experience of it.

4. DISPERSED AREAS IN WILDERNESS

There are 90 miles of known non-system equestrian trails in wilderness that receive no resource protection. Some of them may have existed prior to the Plan; however, many of them were probably created since 1992 from cross-country horseback riding, or following an old road-corridor. Most of these routes are eroding and compacted. Some of them, however, are not causing resource damage and provide access to desired scenic attractions.

5. SIGNS AND ARTIFICIAL MATERIALS

Carsonite posts and painted boundary signs were erected in recent years to delineate natural area boundaries within wilderness and, so, protect natural areas from intrusion and resource damage by horses, camping or campfires. Frequent, painted, reassurance trail-markers and some plastic signs are erected to mark system trails. The Plan specifies axe blazing for reassurance marking, prohibits painted or plastic blazes, and states that all signs will conform to wilderness standards and be kept to a minimum, primarily for direction and safety. The use of artificial materials is inconsistent with the wilderness character, to provide a place "...affected primarily by the forces of nature, with the imprint of man's work substantially unnoticeable" (PL 101-633, 1990). However, the Forest Service is directed to protect the natural areas within wilderness from the damaging effects of horse use, camping and campfires, so some type of signing and boundary marking is needed, with the current policy of allowing cross-country riding, dispersed camping and campfires.

6. NATURAL AREA TRAILS

In general, system trails in natural areas in wilderness are in adequate condition, providing an enjoyable experience while protecting the ecological and scenic resources. The absence of horse use in natural areas without equestrian trails in wilderness since the 1999 closures has improved vegetation re-establishment and the wilderness condition.

7. WILDERNESS VISITS

The total number of wilderness visits surveyed in 2002 was 38,000 (English, 2004). The majority of visitors were between the ages of 31 and 50 years (58 percent). The average length of stay was about 24 hours. Wilderness users expressed satisfaction-levels of Good or Very Good with regard to scenery (100 percent), condition of the natural environment (92 percent), condition of trails (74 percent), feeling of safety (93 percent) and attractiveness of the forest landscape (100 percent). Satisfaction with the condition of old roads, or roads leading to wilderness, and signage is low, with 68 percent and 39 percent, respectively.

The study indicates a high level of satisfaction with many features that make up a wilderness experience, and a lower level of satisfaction with roads, trails and signage. This indicates that current users consider the conditions in wilderness to be generally good; however, trail-signage within wilderness needs to be improved. This study did not measure the satisfaction of individuals that may have stopped visiting wilderness for one reason or another.

The Wilderness Act describes wilderness as having outstanding opportunities for solitude or a primitive and unconfined type of recreation. It specifies an area should have at least 5,000 acres of land, or be of sufficient size to make practicable its preservation and use in an unimpaired condition. These two criteria are difficult to meet in Forest wildernesses due to their smaller total sizes, private land-inholdings in some cases, roads and private lands surrounding their perimeters, and fairly easy access from multiple entry-points in some cases. Currently, all wildernesses allow cross-country use for both hikers and equestrians. In general, visitors indicate that their expectations are met regarding the opportunity for solitude. While more monitoring is necessary in all wildernesses, recent studies indicate that the opportunity for solitude exists even in high-use wildernesses.

Table 3-45. Recreation activities in wilderness by percentage of respondents (n).

Activity	Garden of Gods (n=49)	Lusk Creek (n=148)	Burden Falls (n=46)	Bay Creek (n=19)	Panther Den (n=63)	All 5 Areas (N=325)
Sightseeing	69	65	78	21	59	64
Hiking	57	55	76	16	65	58
Photography	35	36	35	21	22	32
Rock-Climbing	35	25	43	5	36	30
Hunting	16	20	15	95	16	22
Other	6	23	13	10	16	17
Camping	10	18	22	21	9	16
Backpacking	33	11	13	0	8	13
Horseback-Riding	8	19	0	10	8	12
Fishing	4	7	4	5	3	5

Robert Gentry, in an unpublished master's degree thesis (1993), reported the distribution of Forest wilderness users (excluding Bald Knob and Clear Springs) by geographic area. He found that 52 percent of the visitors were from southern Illinois, 28 percent from central or northern Illinois, 8 percent from Kentucky and 4 percent from Indiana. The remaining 3 were from Missouri, Ohio, Iowa, Michigan, Georgia, New Hampshire and California. Garden of the Gods received the highest proportion of non-local visitors—80 percent. About 50 percent of the visitors to Lusk Creek and Burden Falls were non-local.

Gentry sampled 367 wilderness visitors in five of the seven Forest wilderness areas (Table 3-45) to describe demographics and recreational behavior. Sightseeing and day-hiking were the most popular activities, with over 50-percent visitor participation. Photography, rock-climbing and hunting followed, with between 20- and 40-percent participation rates. Camping, backpacking and horseback-riding had an overall 12-percent participation rate, and fishing 5-percent.

Table 3-46. Average group-size in five wildernesses.

	Garden of Gods	Lusk Creek	Burden Falls	Bay Creek	Panther Den	All 5 Areas
Group Size	3.3	5.5	3.6	2.7	3.5	4.3

A similar study for all wilderness areas has not been conducted; however, some activities may have shifted in popularity in the past ten years. Rock-climbing may have dropped in popularity and horseback-riding may have risen. Lusk Creek had a higher participation rate in horseback-riding than the other wildernesses. Gentry found that the average group size in wildernesses was 4.3 (Table 3-46).

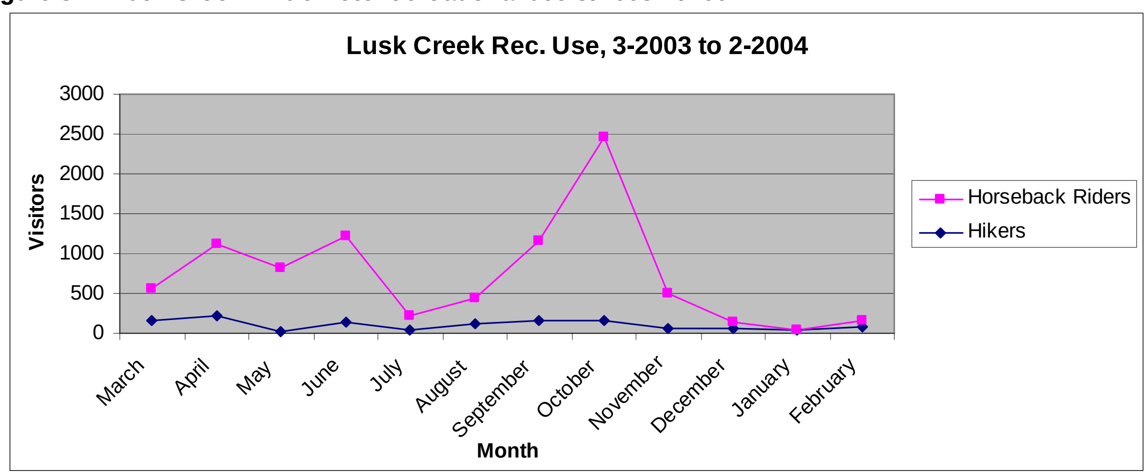
Wilderness-visitor expectations were met for solitude, with an average score of 3.4 on a 5-point scale, where 5 represented "more than expected" and 1 "less than expected." Visitor expectations of scenery were also met, with an average score of 3.8. Physical challenge was rated an average of 3.2. Season-of-use was indicated to be highest during fall (38 percent), second-highest during spring (24 percent), then summer (23 percent). Table 3-47 provides details of seasonal use for each wilderness. Weekend use was also measured, showing a 70-percent use-rate in all wildernesses except Bay Creek, which was 37 percent.

Table 3-47. Seasons-of-use in percent by wilderness.

Seasons	Garden of Gods (n=49)	Lusk Creek (n=148)	Burden Falls (n=46)	Bay Creek (n=19)	Panther Den (n=63)	All 5 Areas (N=325)
Overall	15	46	14	6	19	100
Spring	31	22	28	26	19	24
Summer	12	32	24	0	17	23
Fall	41	30	37	63	48	38
Winter	16	16	11	11	16	15

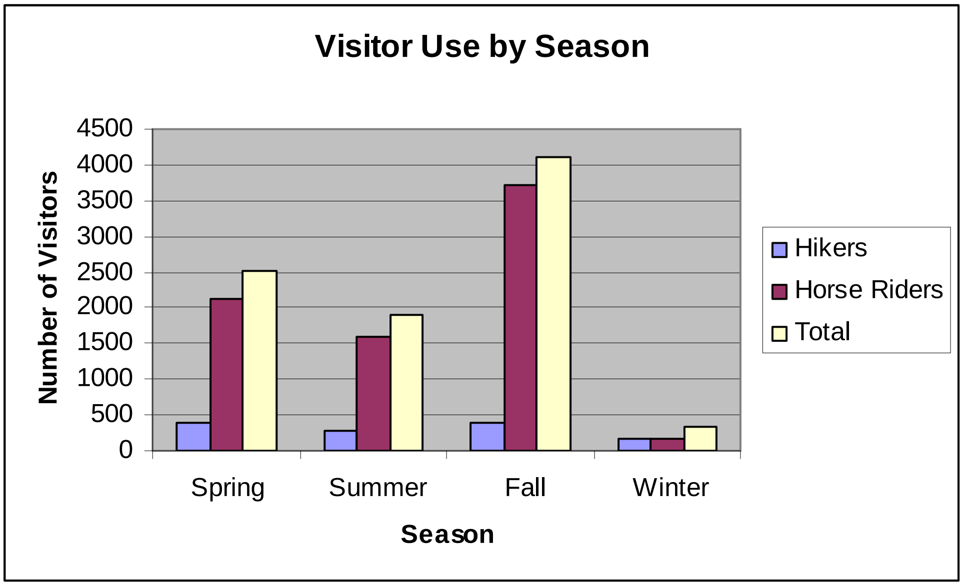
A visitor study was conducted in Lusk Creek Wilderness in 2004 (York, 2004) in partnership between the Forest Service and SIU. The preliminary results indicate a total use of 8,852 in the wilderness: 1,239 (14 percent) hikers and 7,613 (86 percent) horseback-riders (Figure 3-2). Horseback riding increased in 2004 to 86 percent of visitors from about 19 percent in 1993, a significant rise.

Figure 3-2. Lusk Creek Wilderness recreational use 3/2003-2/2004.



Under the 2003-2004 study, the most popular seasons-of-use in Lusk Creek appeared to be fall and spring, with winter having the least amount of visitation (Figure 3-3). The amount of use during weekdays also appeared to increase from 25 percent in the Gentry study to about 55 percent. This could be due to an increase in visitation from northern Illinois and from out-of-state. The final report by SIU will compare data on visitation.

Figure 3-3. Lusk Creek Wilderness visitor-use by season.



To compare weekend to weekday use, the highest-use weekend month for equestrians was September, with an average of 64 horses/day on the most popular system trails (York, 2004). October, on the other hand, had the highest weekday use for horses, with an average of 97/day. The highest-use weekend month for hikers was April, with an average of 25/day. September weekday use was the highest, with an average of 6 hikers/day. Solitude in the Lusk Creek Wilderness can be obtained throughout most of the year; however, there is a greater likelihood of obtaining solitude away from the main trails leading to the primary attractions and during lower-use months.

Garden of the Gods was the second-most highly used wilderness, and the same opportunity for solitude is probably likely today. Solitude and the opportunity for primitive and unconfined recreation would increase away from the main trails leading to the primary attractions and during lower-use months during the spring and fall.

DIRECT AND INDIRECT EFFECTS ON WILDERNESS

The spatial boundary of this analysis for audible, motorized noises includes each wilderness area and an additional one mile beyond its boundary and, for physical features and management actions, includes the area of each wilderness.

Under any alternative in which management practices are proposed, the minimum-requirement tool guide would determine the most effective tools and methods to protect wilderness character. Recreational use could rise, decrease or stay the same under any alternative. Total use within wildernesses may be monitored in the event of significant resource damage, user conflicts, decline in satisfaction with opportunities for solitude, or as specified in project-specific environmental analyses.

Indicators used to measure effects on wilderness include:

- Opportunity for solitude or primitive and unconfined recreation: The opportunity to be isolated from the sights, sounds, and presence of others and from the developments and evidence of humans, and having a high degree of challenge and risk and using outdoor skills.
- Relative natural condition: The degree to which human effects are apparent to most visitors.
- Integrity of ecological, geological, scenic features: The degree to which ecological, geological, or other features of scientific, educational, scenic, or historical value are retained.

1. Restrictive Management

a. Alternative 1

This alternative would recommend Ripple Hollow to be managed as a candidate wilderness study area. If designated as wilderness, the natural areas would eventually convert to a beech-maple overstory, having a direct effect on the ecological integrity.

b. Alternatives 2, 3 and 4

Under Alternatives 2, 3 and 4 the management prescription for Ripple Hollow would not have an effect on wilderness and is described under restrictive management in the recreation section.

2. Roads and Trails Management

Under any alternative, system trails would be constructed and maintained to meet Forest Service Handbook standards for More Difficult or Difficult or, for equestrian trails, Easiest or More Difficult (USDA Forest Service, 1991), and meet National Trail Management Classes 2 or 3 (USDA Forest Service, 2004a). System trails constructed to these standards would have a direct, beneficial effect on the natural condition in wilderness by protecting adjacent resources.

a. Alternative 1

Alternative 1 would not exceed the existing 50 miles of system trail. It would be possible to eliminate some miles and construct new trails as long as the maximum of 50 miles is not exceeded. About 75 percent of the system trails would need to be reconstructed to meet the national Trail Quality Standards (USDA Forest Service, 2002a), or subsequent Forest Service supplements. In the short term, system trails may not meet these standards, which would have a direct effect on the natural conditions within wilderness. However, once improved to the appropriate standards and maintained, system trails would adequately protect the natural condition within the trail corridor only.

The removal of hitching posts at Indian Kitchen in Lusk Creek would be required to comply with Plan standards and guidelines. This facility is located near a scenic attraction and designed to confine effects from horse use to a smaller area, reducing vegetation trampling, soil compaction and tree mortality. Removal of the hitching area could result in adverse resource effects to the adjacent areas from horses tying up outside of a designated area, with a direct, adverse effect on the natural condition.

Temporary equestrian confinement areas placed in locations to protect resources, however, would reduce vegetation trampling, soil compaction and tree mortality in the adjacent area, having a direct effect on the natural condition in wilderness. However, confinement areas should be located out of view of scenic features, in order to maintain the integrity of the feature. Confinement areas within view of the scenic feature could have a direct, possibly adverse effect on the wilderness experience for some users.

Carsonite posts and plastic signs and reassurance markers under this alternative would need to be replaced with signs using natural materials that blend in with the environment, and would need to be placed sparingly. Replacement of signs and markers made from artificial materials to those made from natural or natural-appearing materials, and using sign placement sparingly, would have an indirect effect on the natural condition and improve the primitive character within wilderness. Existing painted reassurance trail blazes would need to be painted over with neutral colored paint and replaced with axe blazes to comply with Plan standards. Axe blazes on trails, placed infrequently, and done carefully so as not to kill the tree, would improve the primitive character along the system trail. Removing existing signs and painted markers, however, could cause increased confusion with a myriad of non-system trails that continue to be used, potentially compromising visitor safety and the natural condition.

b. Alternatives 2 and 4

Under Alternatives 2 and 4, the trail-density standard would be eliminated, allowing the number of miles of system trail to increase, and horses would be restricted to system trails. Additional system trails could be constructed to respond to current and future levels of use. With appropriate funding, new system trails would be located, planned and designed to protect wilderness resources.

Under Alternative 2, system trails that are not constructed to accommodate horse use year round may be closed to horses seasonally, or in inclement weather to reduce adverse trail and resource effects. Seasonal or weather closures would be inconvenient for horseback riders as the number of miles of trails available in wilderness could be reduced in the short term. However, seasonal or weather restrictions would have a direct effect on the natural condition in wilderness by improving conditions on trails not yet meeting standards and reducing adverse effects on adjacent resources. Under Alternative 4, system trails would not be closed seasonally or due to adverse weather conditions, possibly adversely affecting the quality of the system trail and adjacent resources, potentially having a direct effect on the natural condition. Adverse effects on the natural condition in the short term could include vegetation loss, soil compaction and erosion from widened or braided trails.

Equestrian confinement areas could be constructed to protect resources and reduce vegetation trampling, soil compaction and tree mortality, having a direct effect on the natural condition in wilderness. Confinement areas should be located out of view of scenic features in order to maintain the integrity of the feature. Confinement areas located within view of the scenic feature (during leaf-on periods) could have a direct effect on the integrity of the scenic feature.

Managerial controls would increase on system trails and decrease in the general wilderness area. With a greater number of system trails there would be a greater number of miles to manage and sign, having a direct effect on the primitive and unconfined recreation experience in wilderness. In addition, restricting horses to system trails would reduce the need for boundary signs and painted boundary markers around natural areas in wilderness, having a direct effect on the natural condition by reducing an obvious managerial control.

c. Alternative 3

Under Alternative 3, one mile per square mile of system-trail density would be applied to each wilderness, and horses would be restricted to system trails. This would result in the reduction of system trails in Garden of the Gods from 13 miles to 7 and from 4 miles to 2 in Panther Den. These existing system trails would be obliterated by brushing in, removing signs and markers, and controlling erosion. This alternative would not maintain enough system trail miles to respond to current recreational demand.

This alternative would have the greatest beneficial effect on the natural condition in wilderness, with the fewest number of system trail miles and the restriction of horses to system trails. This alternative would allow new construction of up to four miles of system trail in Burden Falls and four miles in Bay Creek Wildernesses, potentially resulting in increased access into these wildernesses. System trails would meet the same trail standards as identified under Alternatives 2 and 4.

Under Alternative 3, all system trails would be closed to equestrians seasonally and in inclement weather. The effects of closure could have a direct effect on the natural condition, especially in the short term, by eliminating adverse effects on system trails and adjacent resources. Not allowing horse use during the winter months (December-February), or during periods of high rainfall, would have an indirect effect on the opportunity for solitude for hikers. Seasonal and weather-related closures would displace wilderness equestrian use to non-wilderness areas and to roads. Displacement could lead to unauthorized cross-country use if replacement system trails are not available. Displacement could also lead to dissatisfaction with the experience of horseback riding for visitors that enjoy a sense of place within their favorite riding areas in wilderness.

Equestrian confinement areas could be constructed to protect resources and reduce vegetation trampling, soil compaction and tree mortality, having a direct effect on the natural condition in wilderness. Confinement areas should be located out of view of scenic features in order to maintain the integrity of the feature. Confinement areas located within view of the scenic feature (during leaf-on periods) could have a direct effect on the integrity of the scenic feature. The effects of trail and natural-area boundary signs would be the same as described under Alternative 2 on only 50 miles of system trail.

3. Recreational Use of Roads and Trails

Under any alternative, the use of unimproved and/or unmaintained system trails could degrade the recreational experience, as well as the natural condition of the wilderness, direct, adverse effects. Unauthorized motorized and mechanized uses could occur, having an adverse, direct effect on the wilderness experience in the short term and on wilderness resources in the long term. Occurrences, however, are expected to be minimal and may not result in effects on resources.

a. Alternative 1

Under this alternative, the number of encounters with others on system trails would be the least of all alternatives since cross-country horseback riding would be allowed. Recreational use on system trails by both hikers and equestrians would be the least under this alternative, having a direct effect on the opportunity for solitude while on system trails, especially during higher-use periods, since riders would have an unlimited array of riding opportunities.

b. Alternatives 2, 3 and 4

With the restriction of horses to system trails in these alternatives, the numbers of encounters with equestrians and hikers on system trails could increase, especially during higher-use months in the fall and spring, having a direct effect on the opportunity for solitude. This could reduce visitor satisfaction. Alternative 3 would have the greatest overall effect on solitude while on system trails, since it would allow the least total number of miles of trail. Hikers, however, could experience greater opportunities for solitude under Alternative 3, and somewhat under Alternative 2, with seasonal and weather-related system-trail closures to equestrians. Under all three alternatives, unauthorized, cross-country, equestrian use could occur, having adverse effects on wilderness resources. Compliance with the restriction of riding to system trails would ensure these effects are minimal.

Alternatives 2 and 3 allow the imposition of a group-size limit without specifying the size. Larger groups have the potential of having loud conversations and are more noticeable in an encounter than smaller groups or individuals. On the other hand, participants surveyed in wilderness are generally highly satisfied with their experiences (USDA Forest Service, 2002; Gentry, 1993), indicating that group-size limits may have a limited relationship to a beneficial wilderness experience. Cole (1997) found that larger groups of people, particularly with horses, cause greater ecological effects than small groups in areas that are relatively undisturbed. However, where pre-existing effects are high there is little difference in the effect between larger or smaller groups.

The average group-size in Lusk Creek in 1993 was six people (could include six individuals with six horses). Twenty-five heads (people or stock) is the most common group-size limit used in wilderness in the Forest Service (Monz *et al.*, 2000). In two published reports, encounters with groups of people did not detract from the enjoyment of wilderness (Cole *et al.*, 1997; Monz *et al.*, 2000); however, encounters with groups with horses were adverse for a larger proportion of visitors than encounters with groups without horses. In addition, there is a large discrepancy in how each individual defines solitude.

4. Dispersed Recreational Use

Under any alternative, hikers would be allowed on system trails and to walk cross-country. The opportunity to experience primitive and unconfined recreation would be the same.

a. Alternative 1

Under this alternative, allowing cross-country horseback riding could have a direct, beneficial effect on the opportunity for solitude and primitive and unconfined recreation for horseback riders. It could also have a direct, adverse effect on the opportunity for solitude for hikers off of system trails by increasing the likelihood of encounters. Opportunities for solitude for hikers, however, remain high under this alternative when they are away from system trails, and especially during lower-use seasons because of the tendency of most horseback riders to stay on well-defined trails to popular scenic attractions.

Allowing cross-country riding could have a direct, adverse effect on the natural condition in wilderness from non-system trails. These trails receive equestrian use, but no maintenance, leading to erosion and vegetation compaction. This is especially true in Lusk Creek, with high equestrian use. In Clear Springs, Bald Knob and Panther Den Wildernesses, however, cross-country use is rare, with minimally adverse, direct and indirect effects on the wilderness character.

No adverse effects are anticipated from other recreational uses on the wilderness natural condition or opportunity for solitude.

b. Alternatives 2, 3 and 4

Restricting horses to system trails in these alternatives would eliminate equestrian use on many miles of non-system trails and cross-country. This action would reduce erosion, tree-mortality and vegetation-loss in the general forest area and on non-system trails, having a directly beneficial effect on the natural condition of each wilderness. Winter and/or other seasonal closures to equestrian use under Alternatives 2 and 3 would also reduce the muddy conditions on unimproved system trails caused primarily by horse use during freeze-thaw periods, further improving the natural condition within the system trail corridor.

Restricting horses to system trails would eliminate a primitive and unconfined recreational opportunity for horseback riders in wilderness, having a direct, adverse effect on this experience. Under Alternative 3, system trails would be limited to about 50 miles, offering fewer potential riding opportunities than under Alternatives 2 and 4. Restricting horses to system trails would also place an inconvenience on many adjacent landowners, requiring that they trailer their horse to a system trail or trailhead. Equestrian use would not be allowed on thousands of acres away from system trails, decreasing opportunities for solitude, having a direct, adverse effect on this experience.

5. Developed Recreational Site Use

There are no developed sites within wilderness; no direct or indirect effects are anticipated under any alternative.

6. Timber Harvest

There are no timber harvest methods planned in wilderness. No direct or indirect effects are anticipated under any alternative.

Salvage timber harvesting practices could be implemented to prevent the spread of insects and disease, if there is risk of loss of resources on adjacent lands or loss of wilderness resources. In the case of timber extraction, mechanical equipment may be seen, having a direct effect on the opportunity for solitude. In the long-term, salvage timber harvesting could benefit the wilderness resource by minimizing loss of mature timber, having a direct effect on the natural condition. Salvage timber harvesting could also have an adverse effect on the natural condition in wilderness by disrupting a natural process.

7. Vegetation Treatments

Prescribed fire (covered in section 8) and vegetation treatment associated with integrated pest management (covered in section 9) are the only treatments anticipated this planning period. No additional measurable direct or indirect effects are anticipated under any alternative.

8. Fire Management

Under any alternative, wildfires may occur in wildernesses. Periodic fire is an important part of the ecosystem and health of many plants and animals. Effective fire suppression for many decades has largely excluded beneficial fires from the wilderness, resulting in a much higher than normal natural-fuel load. As a result, wildfires have the potential to be much larger, causing more severe effects to wilderness resources than would be expected under more natural conditions. The proximity of adjacent private lands and resources is also of high concern in allowing natural fire to play a natural role within wilderness. While wildfire occurrence is an event of small total acreages, they are also highly likely to be suppressed when small, having an indirect effect on the natural condition and ecological features and processes within wilderness. During the suppression of wildfires, visitors may see bulldozers or other motorized equipment and hear chainsaws or portable pumps, having a direct effect on the opportunity for solitude during operations. Loss of vegetative cover from wildfire may increase the view of other visitors, having a direct effect on the opportunity for solitude.

Under any of the alternatives, naturally occurring fires will be allowed as nearly as possible to play their natural ecological role, and reduce natural fuel buildup to an acceptable level that will minimize the risks and consequences of wildfire within wilderness or escaping from wilderness. Wildfires in wildernesses that do not have a fire management plan will continue to be suppressed. Allowing naturally occurring fires would normally have beneficial direct effects on the natural condition in wilderness and on the integrity of ecological features. Wildfire suppression to protect wilderness or adjacent resources and private properties may also reduce the loss of mature forests, having a direct effect on the wilderness natural condition. Earth-moving suppression tactics, such as bulldozer lines would need to be rehabilitated to mitigate the effect on the wilderness natural condition.

Under any alternative, prescribed fire can be used to reduce to an acceptable level, the risks and consequences of wildfire within or escaping from wilderness. The use of prescribed fire would have a direct effect on the opportunity for solitude with clearer views of other visitors in the short term. However, in the long-term, the effect of fire would have an indirect effect on the vegetation and improve the relative natural condition and ecological features and processes that have essentially been excluded. The absence of fire in wilderness will accelerate the conversion of an oak-hickory forest type to a more shade-tolerant beech-maple forest type in the long term, having an indirect effect on the ecological integrity of features within wilderness.

9. Integrated Pest Management

Under any of the alternatives, pest management would have a directly beneficial effect on the natural condition by reducing or preventing the spread of non-native invasive species. This could result in the presence of dead plants for one or two growing seasons, a beneficial, indirect effect on the natural condition.

10. Openings and Openlands Management

Openlands would not be managed in wilderness areas. No direct or indirect effects are anticipated.

11. Aquatic Resource Management

Aquatic resource management could occur for wildlife habitat improvement on a site-specific basis. No direct or indirect effects are anticipated on the wilderness environment or experience from this management activity.

12. Land-Ownership Adjustment

Land-ownership adjustments that result in the acquisition of lands that can be included in wilderness areas would increase the opportunity for solitude and primitive recreation, having a direct effect on these experiences.

CUMULATIVE EFFECTS ON WILDERNESS

This discussion of cumulative effects takes into consideration the effects of the past, present and reasonably foreseeable future actions specified within the analysis boundaries at the beginning of Chapter 3.

Their designation by congress ensured the protection of the seven wildernesses on the Forest, as well as the Crab Orchard Wilderness managed by the US Fish and Wildlife Service adjacent to Panther Den Wilderness. Designation has led to protection from many management activities, such as timber harvesting, surface oil-drilling, and others. It has also attracted more recreational users to scenic areas within some wildernesses and to nearby commercial, equestrian camps, leading to adverse effects on wilderness character over time. The use of system trails properly located, designed and maintained would result in beneficial effects on wilderness character.

Wilderness regulations require that most management be conducted manually, reducing the ability to maintain any fire-dependent plants and/or communities in the wilderness interiors, and possibly leading to the loss of this community. Allowing repeated, prescribed fire over time would have a beneficial effect on wilderness character, restoring or enhancing the native plant communities. The length of time in which noise could be heard from within wilderness areas from vehicles, power tools and ATVs could increase with increased use and increased management activities. The cumulative effect of motorized noise, in combination with more trail restrictions and increased management, could have an adverse effect on the wilderness experience, depending on the visitor.

1. Alternative 1

Considering past, present and reasonably foreseeable future actions both on and near the Forest, and the effects on wilderness areas, implementation of Alternative 1, with the potential for increased horse use, would result in minimally adverse, cumulative effects on the character of those wildernesses within which equestrian use would be allowed. Otherwise, cumulative effects would be minimally beneficial to immeasurable

2. Alternatives 2, 3 and 4

Considering past, present and reasonably foreseeable future actions both on and near the Forest, and the effects on wilderness areas, implementation of any of these alternatives would result in beneficial cumulative effects on wilderness character.

I. RECREATION

The Forest is considered by many to be the primary outdoor-recreation attraction in southern Illinois. It has the largest consolidated land-base of all public lands in Illinois. Many attractions, including scenic vistas, historic sites, wilderness areas and trails are marketed by federal, state and private tourism organizations and individual businesses, increasing non-local use. Some businesses in rural southern Illinois depend on tourism revenue created by recreational opportunities offered on the Forest. With about 12-and-a-half million residents within 200 miles, the Forest is less than a one-hour drive from Indiana, Kentucky and Missouri. While Illinois residents are the primary visitors, the Forest is enjoyed by tourists from many other states.

1. RECREATION OPPORTUNITY SPECTRUM (ROS)

The ROS is a combination of activities, settings and probable experience opportunities arranged along a continuum. There are six classes defined in ROS: primitive, semi-primitive non-motorized, semi-primitive motorized, roaded natural, rural and urban.

These classes help Forest visitors identify areas with specific recreational opportunities (USDA, 1982). Table 3-48 displays the Forest acreage in each of the ROS classes.

Three ROS experience-classes are represented in the Forest Plan: roaded-natural, semi-primitive non-motorized and rural. No area of the Forest is sufficiently remote or large to be managed as primitive class, or sufficiently developed for the urban class. All of the developed recreational sites on the Forest generally meet the criteria for roaded-natural or rural classes, and most recreational opportunities fall within the roaded-natural class. Roaded-natural can be managed for either motorized or non-motorized experiences. About 65 percent of the acres in roaded-natural could be managed for ATV/OHM uses. However, no recreational motorized use is authorized on trails or away from established roadways, except for people with disabilities.

Table 3-48. Forest acreage in each ROS class.

ROS Class	Acres
Primitve	0
Semi-primitive non-motorized	5,576
Semi-primitive motorized	6,078
Roaded-natural	271,348
Urban	0

2. GENERAL RECREATION

The total number of visitors to the Forest in 2002 was about 585,000 (USDA Forest Service, 2004). Slightly less than half visited more than one developed recreational site during the same visit. In general, recreational use differs by season, with pleasant days in early spring (March) bringing out wildflowers and mushrooms. Recreational use in early spring includes driving for pleasure; walking or hiking; mushroom hunting; wildflower, wildlife and nature study; and fishing.

In April and May, horseback-riding increases as the privately owned, commercial, equestrian camps open. Turkey-hunting occurs through mid-May and picnicking, camping and fishing increase. Bicycling and rock-climbing begin; boating and other spring activities increase. Driving on backcountry—native-surface—roads begins mid-May. The primary season for swimming is June through the Fourth of July, while June, July and August are the peak months for water-oriented recreation, especially boating and fishing. Most activities, other than those water-oriented, decrease from the Fourth of July through August due to the heat, humidity, poison ivy and ticks. Squirrel-hunting season extends from August through November.

Most active, outdoor, recreational activities, such as hiking, horseback-riding and bicycling, rock-climbing and camping become prominent again in September and October. Colorful, fall foliage attracts many pleasure-drivers and photographers. Bow season initiates the white-tail deer-hunting season that concludes in December with the gun and muzzle-loading season. Waterfowl-hunting is the primary recreational activity in the humid and cool, winter months of December and January. The Forest has minimal snow-based activities because of mild winters and light snowfall. Nature study occurs on the Forest year-round.

The four main recreational activities occurring on the Forest in 2002 included relaxing, viewing scenery, viewing wildlife and walking, with participation rates greater than 40 percent for each activity (USDA FS, 2002). The seven next-most popular recreational activities included picnicking and family gatherings in developed sites, pleasure-driving, swimming or games and sports, fishing, visiting historic and/or prehistoric heritage sites, visiting a nature center or trail and camping in developed sites, with participation rates greater than 15 percent for each. Nature study, hunting and horseback riding were activities with participation rates greater than 5 percent. Primitive camping, backpacking, motorized water activities, bicycling, canoeing and the gathering of mushrooms or berries each had participation rates of less than 5 percent.

The Forest is primarily a day-use provider, with almost half—48 percent—of all visitors using non-motorized trails (USDA FS, 2002). More than one-quarter of the visitors used picnic and swimming areas. Ten percent or more used scenic byways, forest roads, interpretive sites and developed campgrounds. Visitors are generally satisfied with their visit, with scenery having the highest scores and condition of forest roads and adequacy of signage having the lowest scores (USDA FS, 2002). The perception of crowding was low in the general forest area and in wilderness (USDA FS, 2002).

a. Visitor Demographics

The majority of visitors are local residents within a half-hour drive of the Forest (Figure 1). The majority are male (78.2 percent); 98 percent are white. Twenty-three percent are under 20 years old, 52 percent between the ages of 20 and 50, and 25 percent over 50. The average length of stay on the Forest is 12 hours and, in wilderness, 24 hours. Over 11 percent of visitors stayed overnight (USDA FS, 2002).

b. Developed Recreation

There are 44 developed recreational sites on the Forest (Tables 3-49a and 3-49b). The capacity of a recreational site is measured by identifying the total number of “people at one time” (PAOT) that the recreational area can accommodate comfortably. The SNF Recreation Maintenance Report for fiscal year 2000 notes the total capacity for the developed recreational sites on the Forest to be 9,668 PAOTs: 6,793 on the Hidden Springs Ranger District and 2,875 on the Mississippi Bluffs Ranger District.

Total deferred maintenance costs in developed recreation are about $3,647,000. Annual operating costs are about $375,500. Ten years of annual operation and maintenance and deferred maintenance costs is about $9,622,500. (These cost estimates do not include NEPA analysis, planning and design, but do include a 30-percent overhead cost.)

Deferred maintenance costs are high primarily due to the age of facilities. Most were constructed or reconstructed in the 1960’s and 1970’s, and a few in the 1930’s and 1940’s. The functional life of a facility is generally 20 to 25 years. Many of the recreational facilities on the Forest are in disrepair and facing the prospect of closure or conversion to an alternative use.

Table 3-49a. Developed recreational sites on the Hidden Springs Ranger District, capacity and cost (INFRA Database, 2004).

	Site	Site PAOTS	Subtotal Cost O&M ($)	Needed Cost COF ($)	Total Needed Cost ($)
	Bell Smith complex	347	10,870	30,395	41,265
	Lake of Egypt complex	655	12,013	17,882	29,895
	Lake Glendale complex	2,018	6,539	14,782	21,321
	Indian Kitchen trailhead	50	1,070	388	1,458
	Jackson Falls family campground	45	2,671	2,708	5,379
	Dutchman Lake recr area fishing site	30	1,842	6,17	2,459
	Trigg Tower interpretive site (minor)	60	1,378	159	1,537
	Little Cache boat ramp fishing site	24		0	
	Burden Falls access trailhead	20	533	80	613
	Jackson Hollow access trailhead	30		0	
	New Home trailhead	10		0	
	Millstone Bluff inter site (minor)	120	4,568	144	4,712
	Garden of the Gods complex	980	38,461	104,459	142,920
	Pounds Hollow complex	811	68,552	645,864	71,4416
	Tower Rock complex	361	11,751	9,654	21,05
	Stoneface trailhead	30		0	
	Camp Cadiz group campground	20		0	
	Camp Cadiz family campground	75	9,549	8,711	18,260
	Whoopie Cat Lake fishing site	25	7,671	0	7,671
	Illinois Furnace family picnic area	411	18,502	9,229	27,731
	Illinois Furnace interpretive site	256		0	
	High Knob observation site	36	12,512	30,109	42,621
	Lake Tecumseh rec area fishing site	25	4,954	251	5,205
	Rim Rock family picnic area	330	14,726	5,058	19,784
	One-Horse Gap fishing site	15	1,159	7,326	8,485
	Saline Springs documentary site	9		0	
	Total		6,793	229,321	1,117,137

Table 3-49b. Developed recreational sites on the Mississippi Bluffs Ranger District, capacity and cost (INFRA Database, 2004).

	Site	Site PAOTS	Subtotal Cost O&M ($)	Needed Cost COF ($)	Total Needed Cost ($)
	Government rock observation site	10	2,572	83	2,655
	Bean Ridge Pond fishing site	50	3,090	113	3,203
	Godwin trailhead-east	15	1,101	362	1,463
	Allen's Flat family picnic area	15	3,353	1,991	5,344
	Winter's Pond family picnic area	28	2,940	162	3,102
	Inspiration Point observation site	20	1,136	71	1,207
	Grapevine Trail campground	30	4,904	5,658	10,562
	Pine Grove observation site	5		0	
	Clear Springs family picnic ground	30	1,050	109	1,159
	Lincoln Memorial picnic area	165	45.773	25.980	71,753
	Old Trail Point observation site	10	2,091	**?**	**?**
	Saddle Hill observation site	10	2.358	51	2,409
	Pine Hills family campground	104	8,112	1,157	9,269
	McCann Springs family picnic area	15	2,237	88	2,325
	Upper McGee Hill picnic area	15	2,663	168	2,831
	Crooked Tree observation site	10		0	
	Lower McGee Hill obser site	25	2,109	34	2,143
	Kaolin Pond interp site (minor)	20	1,780	93	1,873
	Johnson Creek complex	1,170	22,140	473,828	495,968
	Howardton Access trailhead	10		0	
	Buttermilk Hill trailhead	50		0	
	Black Pond wildlife-viewing parking	50		0	
	Pomona Road trailhead	10		0	
	Greentree Reservoir interp site	60	19,809	88,211	108,020
	Little Grand Canyon picnic area	45	4,635	1,878	6,513
	Pomona Natural Bridge picnic area	25	1438	458	1896
	Pomona boating site	125	3,751	13,833	17,584
	Turkey Bayou boating site	20	2,301	4,067	6,368
	Turkey Bayou family campground	85	4,840	18,485	23,325
	Big Muddy River boating site	20	2,210	31,980	34,190
	Oakwood wildlife-view blinds site	10		0	
	Sharp Rock Falls boating site	125		0	
	Buttermilk Hill family picnic area	200	8,687	77,892	86,579
	Conservancy District boating site	150		0	
	Cedar Lake rec area picnic site	60		0	
	Cove Hollow trailhead	28	1,678	157	1,835
	Boar Bristle wildlife-view parking	30		0	
	Hidden Cove trailhead	25		0	
	Total		2,875	158,758	903,576

Campground use on the Forest is low. Overnight use is recorded from campground fee envelopes that provide information such as the amount of use a campground receives, the number of nights occupied, revenue and seasons of occupancy. Campground occupancy rates are found in Table 3-50. Occupancy is calculated by dividing the number of nights all of the campsites are occupied by the number of nights the campsites are available during the season. The average occupancy rate for campgrounds from 1997 to 2000 was about 11 percent (USDA FS, 2001a).

Table 3-50. Forest campground annual occupancy (%).

Fee Campground	1997	1998	1999	2000
Teal Pond	11.5	9.7	7.8	9
Camp Cadiz	13.9	9.8	16	16.5
Pharaoh – GOG	28.6	27.5	32.7	32.9
Pine Hills	2.3	7.4	7.7	5.8
Turkey bayou	1.2	5.8	4.7	3.6
Red Bud (Bell Smith)	10.6	12	12.3	14
Tower Rock	7.6	6.9	7.4	8
Buck Ridge (LOE)	3.6	2.4	4.6	4.3
Oak Point (Glendale)	22	19	22	7.5[1]
Johnson Creek	3.8	2.1	1.6	
JC Family Camping				2.8[2]
JC Hike-in				0.55[2]
JC Group Camping				1.3[2]
Pine Ridge (Pounds Hollow)	14	15	8	11.8
ANNUAL AVERAGE	10.8	10.7	11.3	11.0

FY 97 – Pine Hills – Tube fee theft
FY 01 – Oak Point under concession begin mid-May
[1] Not included in average [2] Included as a single entry

c. Roads Management

The Forest is within a one-day drive for one-fifth of the nation's population; the majority of visitors arrive by automobile. The major transportation links that serve the Forest are Interstate Highways 24 and 57. Other primary access is by a network of federal, state and county highways. Bridges providing access across the Ohio and Mississippi Rivers are widely spaced, and one ferry continues to operate on the Ohio River, near the community of Cave-in-Rock.

Historically, a network of county and township roads has provided secondary access. Most of these secondary access roads were established, and have been used, since the settlement of this region. The small farms that were acquired to create the Forest had an extensive system of roads because the early settlers owned relatively small parcels—160 acres or less—and road access was needed to each parcel. The location of some of these roads appears to be on “the path of least resistance” rather than the most environmentally suitable route.

Many of these roads were built to serve the transportation needs of the area 50 to 100 years ago and were utilized by varying forms of agricultural equipment and other means of transportation. These roads not only provided ingress and egress to landowners but also were used as routes to schools and by the general public. In some cases, this public use may have led to the establishment, prior to acquisition by the United States, of “prescriptive easements,” defined by Black’s Law Dictionary as, “The right to use another’s property which is not inconsistent with the owner’s rights and which is acquired by a use, open and notorious, adverse and continuous for a period of twenty years." Table 3-51 presents road mileages on the Forest by jurisdiction.

History indicates that maintenance of the roads within these prescriptive easements varied widely. In some cases, it appears that the landowners provided maintenance, in others, the agencies of county or township governments; but the need for maintenance declined as homesteads were abandoned and the United States acquired the land. This lack of maintenance, along with reasonably extensive travel by a variety of vehicles, has resulted in the poor condition of many of the county and township roads crossing the Forest.

Table 3-51. Road mileages by jurisdiction.

FS Level-1 & -2 Roads	FS Level -3, -4 & -5 Roads	Total FS Roads	County & Township Roads Subject to Seasonal Closure	County & Township Roads Not Subject to Seasonal Closure	Total County & Township Roads	Total roads in All Jurisdictions
458	168	626	76	2,735	2,811	**3,437**

The road network within the proclamation boundary is 3,437 miles (USDA FS, 2004). About 82 percent of this mileage (2,811 miles) is under jurisdictions other than the Forest Service, with a formal or prescriptive easement. The remaining 18 percent (626 miles) is under national forest jurisdiction. The roads under national forest jurisdiction (commonly referred to as Forest System roads) are divided between 168 miles of maintenance level-3, -4 or -5 roads and 458 miles of level-1 or -2 roads. The five maintenance levels are:

- Level 1: Considered closed and receiving no scheduled maintenance other than for the protection of adjacent resources.
- Level 2: Neither designed nor maintained for passenger vehicles. These may or may not be surfaced and may be constant-service or intermittent for high-clearance vehicles only. They may be subject to seasonal closure limiting or prohibiting use by motorized vehicles and gated, signed and/or bermed to enforce the closure.
- Level 3: Generally open to travel by all vehicles, including passenger vehicles. User comfort and convenience are not considered priorities. Subject to seasonal closure.
- Level 4: Generally open to all motorized travel, with consideration for user comfort and convenience. All types of recreation and other public use are encouraged. May have seasonal vehicle size-restrictions and closures generally associated with the maintenance or repair of the travelway or adjacent resource.
- Level 5: Generally open to all motorized travel, with consideration for user comfort and convenience. All types of recreation and other public use are encouraged. No restrictions other than maintenance closures should be expected.

Roads crossing the Forest include those under federal, state, county and township jurisdictions, or those that serve private landowners. Roads managed by public agencies are usually considered uses-in-perpetuity and are authorized by a permanent easement (written or prescriptive). Roads privately maintained for access to privately owned parcels may be authorized for a few months to several years, then reclaimed or turned over to the Forest. Roads that provide access to privately owned parcels are usually authorized by permit requiring an annual fee.

Annual maintenance is routinely performed on about 60 miles of level-1 and -2 roads and 110 miles of level-3, -4 and -5 roads. About 430 miles of Forest Service roads receive no annual maintenance due to the fact that, in accordance with 36 CFR 212.5, the Forest may restrict or control these roads to meet management objectives.

d. Recreational Road Use and Trail Management and Use

Under all alternatives, trail standards and management would follow national trail management classes 1-5 and the ROS for experience-levels. The Forest Service Handbook also identifies various construction standards for different types of trail or road uses. A trail-corridor map was printed as part of the 1992 Plan. It identified a 286-mile corridor within which ATV-hiker-equestrian trail routes could be designated, as well as 338 miles of potential hiker-equestrian trail routes. Both mileage estimates included road connections.

Table 3-52. Trail miles and costs outside wilderness.

Trail miles	Annual trail maintenance cost for 145 miles	Reconstruction cost with gravel for 56 trail miles	Reconstruction without gravel for 56 miles
290	$435,000	$679,112	$318,864

There are currently 290 miles of non-wilderness, Forest system trails (Table 3-52), including road-connections (149 miles of non-road and non-wilderness system trails and 141 miles of road-connections) (USDA, 2004). Thirty miles of system trail are designated for hiker-use only. The remainder (260 miles) is open to hikers and/or horseback riding. Motorized use is prohibited on all non-road portions of system trail routes. Equestrian use is not restricted to designated system trails except in natural areas and some developed recreational areas.

Trail infrastructure currently is lacking in adequacy to accommodate equestrian use year-round. Maintenance frequencies are also inadequate due to lack of funding. The cost of trail maintenance is estimated at $3,000 per mile for light maintenance (tree removal, vegetation trimming or removal, signing, minor tread work). For trail maintenance, road-connection miles are included, due to the trail maintenance performed. For trail reconstruction, however, road-connection miles are not included since reconstruction would occur only on segments of trail and not roads. Half of the 290 system-trail miles (non-wilderness) require maintenance at least annually. Seventy-five percent of the non-wilderness system trails require reconstruction due to the level of equestrian use.

Many native-surface roads are utilized as travel-routes for non-motorized uses. Many of these routes have the character of a trail or narrow road and lead to system trails or other desirable attractions. There are about 196 miles of level-1 roads closed to public motorized vehicle use year-round, and 262 miles of level-2 roads seasonally open to public motorized vehicle use, some of which provide a quality riding and/or hiking experience. When level-2 seasonal roads are open to vehicle use, bicyclists may use them as well. When they are closed to vehicles, equestrians and hikers may continue to use them. Road-closure devices used on these roads may be gates, wooden barriers, earthen berms or signs.

Many miles of level-1 and -2 roads are in poor condition from lack of maintenance and regular use by equestrians, four-wheel-drive trucks and other vehicles, and unauthorized ATV/OHM use. Although the 1992 Plan does not permit bicycles on system trails or on roads closed to public vehicles, a Forest Supervisor's order has not been issued to prohibit bicycles. As a result, many bicyclists utilize trails and roads.

In addition to system trails and roads, many miles of user-developed trails exist. There are about 350 miles of these generally equestrian trails in the four most heavily-used watersheds on the Forest: Big Grand Pierre Creek, Lusk Creek, Bay Creek and Eagle Creek. (The mileage of these trails in wilderness is discussed in section J.) Equestrian use is permitted on those user-developed trails that existed prior to the 1992 Plan; however, since the trails were not documented prior to the Plan, it is frequently difficult to distinguish the newly developed ones from the old.

Table 3-51 presents the trail-density standards in the 1992 Plan and the current trail-densities by management area. Trail densities comply with standards in most management areas, although they are exceeded in the wilderness study area. This is due to the conversion of old roads to trails and the resulting increase in trail mileage. Trail density outside wilderness has not been raised as an issue during this planning period. (See section J for discussion of trail-density within wilderness.)

Table 3-53. Forest Plan trail- and road-density standards and current densities.

MA	Square miles	Trail-density standard miles/ square mile	Trail miles/ MA (including road connects)	Trail density	Road-density standard (for public use) ms/sq mile	All jurisdiction road density/ square mile (level-3,-4 &-5)*	All levels road density
OB	7.34	No limit	0.85	0.12	.6	0.9	3.4
UH	214	2	125.75	0.59	.6	8.2	9.8
WD	44	1	44.5	1.0	0	0.1	0.2
FR	9.12	2	0	0	.6	1.4	1.9
FI	14.5	No limit (low)	11.93	0.82	No limit (low)	0.9	2.3
CV	3.14	2	1.71	0.54	No limit (low)	.8	3.5
MH	58.23	2	62.91	1.08	.6	2.3	3.5
DR	2.51	No limit (high)	11.43	4.55	No limit (high)	5.9	6.4
RA	12.02	1	0.01	0	2-5	1.8	3.1
NA	23.11	No limit	18.22	0.79	1	.7	.97
HR	6.66	No limit	6.98	1.0	1	1.9	3.3
MM	15.58	No limit	33.13	2.12	No limit	51.4	52.4
CR	22.78	2	5.14	0.23	No limit (low)	3.5	4.7
RW	5.8	1	11.77	2.0	No limit (low)	.6	1.4
CH	5.84	1	4.82	0.83	0	2.3	2.9

* Does not include level 2 roads, also open seasonally.

Trail- and road-densities were thought to be an indicator of a quality recreational experience, i.e., the lower the trail- and/or road-density, the greater the potential for solitude or fewer encounters on system trails or roads. In practice, trail or road placement, design, maintenance and the types and amounts of recreational uses allowed on a trail or road are much better indicators of a quality recreational experience. This is true particularly in eastern hardwoods, where the viewshed is fairly confined to a few hundred feet on either side of the trail or road. This is in contrast to an open environment, such as a western plain, where trail users can be seen great distances on different trails. With small acreages in some management areas, lack of consolidated ownership and lack of jurisdiction on the majority of the roads, trail- and road-densities can be high, but have no effect on experience because use is low. On the other hand, road- or trail-densities can be low, but the recreational experience poor due to bad road condition, high use or recreational use conflicts.

e. ATV/OHM Trails and Use

The 1992 Plan identified a 286-mile corridor within which ATV/OHM, hiker and/or equestrian trail-routes potentially could be designated. A court injunction restricted the Forest from designating trails within the corridor and from allowing ATV/ OHM use, except for administrative purposes or by people with disabilities (U.S. District Court, 1995). Although the Forest is closed to ATV/OHM use, except for administrative purposes or by permit, there is a high incidence of unauthorized use in many areas. Very few citations have been issued for this unauthorized use due, in part, to the inability of law-enforcement personnel to be present in all the areas of high use or to apprehend violators who easily can evade capture. Evidence of ATV/OHM use has been found only occasionally in wilderness (York, 2004) and in natural areas. Unauthorized use is difficult to determine unless operators are found at the time of an incident without an accessibility permit.

f. Commercial Recreational Uses

Many tourism providers—equestrian campground owners, institutions, guides and various nature organizations—have applied for recreational commercial-use permits to provide outfitting and guiding services and/or to host commercial recreation events. Non-commercial and commercial recreation-use permits are issued each year, primarily for activities such as hunting, hiking, camping, horseback riding, canoeing and/or rock-climbing.

One large equestrian event, the Nine-Day Ride, occurs in July and attracts about 2,000 riders each year. This event has been held for about 35 years and draws riders from many states. Most of the camping is done on privately owned land, but several adjacent Forest acres are permitted for camping. Riding occurs primarily on Forest lands and on system, permit-sanctioned, user-developed trails. Commercial recreational permits and non-commercial group-use permits serve about 4,000 individuals on foot and 3,000 equestrians each year.

3. RECREATIONAL USE AND VISITS

General local and non-local recreational use—measured in numbers of visits—is presented in Table 3-50. Numbers are taken from the *National Visitor Use Monitoring Survey*, 2000 and projected to the year 2015, then adjusted based on the differences among alternatives. Local use is based on a local population that is not expected to rise or fall by 2015 (most counties are projected to decline and a few counties are projected to increase) (U.S. Census, 2000). Non-local use is expected to increase by a modest one percent each year.

Tourism-marketing to non-local tourists by state and local organizations is expected to continue or rise. With increased marketing, recreational use could increase. However, since non-local use is a fairly small proportion of overall use, this is not expected to result in a significant increase in total use.

DIRECT AND INDIRECT EFFECTS ON RECREATION

1. Restrictive Management

Under any of the alternatives, restrictive management would protect and enhance opportunities and settings for natural, cultural, or backcountry, recreational experiences. This represents generally beneficial, direct and indirect effects for visitors seeking such experiences.

Under Alternative 1, Ripple Hollow would be managed as a wilderness study area and the Camp Hutchins area as a non-motorized recreational area, resulting in beneficial, direct and indirect effects on those seeking non-motorized recreation. Under Alternatives 2 and 3, the Ripple Hollow and Camp Hutchins areas would be managed as non-motorized recreational areas, with comparable beneficial effects. Alternative 3 would also manage the Burke Branch area as a non-motorized recreational area. Alternative 4 would manage the three areas under the Mature Hardwood Management Prescription, resulting in beneficial, direct and indirect effects on those seeking motorized recreation.

2. Roads and Trails Management

The analysis of effects focuses only on the 626 miles of Forest System roads. Forest officers would continue to consult with representatives of local road-management agencies, but elimination of non-Forest-Service-jurisdiction roads cannot be projected. Most parcels of privately owned land that require use of adjacent national forest land for ingress and egress already have developed access, but some new access roads on national forest land could be needed. Roads and trails would be maintained to the appropriate Forest Service standards that provide for the intended experience and protect resources, providing beneficial, direct effects for the users of the roads and trails.

a. Alternative 1

Under Alternative 1, the probable silvicultural practice would be uneven-aged management, which could generate the need for permanent and temporary roads to reach harvest sites. Minerals development could also require temporary access roads to exploration or development sites. Temporary roads would be obliterated upon completion of the activity; they could represent beneficial or adverse, direct and indirect effects on the recreational user, depending on the activity desired. Recreational use is expected to require approximately 87 miles of permanent roads as connectors on Forest Service roads for ATV/OHM system trails, providing beneficial, direct effects for ATV/OHM users.

Offering ATV/OHM opportunities where none currently exist would have a direct, adverse effect on licensed, motorized, recreational opportunities. Expanding the trail system from current levels would have a direct, beneficial effect on opportunities for non-motorized recreation. The number of miles of system roads decommissioned each year could have a direct, adverse effect on licensed, motorized recreation.

b. Alternative 2

Alternative 2 prescribes a probable combination of thinning and shelterwood harvest, resulting in an anticipated low need for permanent roads; however, some temporary roads could be required. Minerals development could require temporary access roads to exploration or development sites. These would be obliterated on completion of the activity; they could represent beneficial or adverse, direct and indirect effects on the recreational user, depending on the activity desired. Alternative 2 could include up to 700 miles of non-motorized trail and 626 miles of road.

ATV*s* and OHM*s* would not be allowed under this alternative, having a direct, adverse effect on those seeking this motorized recreational opportunity, but direct, beneficial effects for those desiring a quieter recreational experience. An increase in non-motorized system trails is proposed, with a direct, beneficial effect on non-motorized recreational opportunities. Seasonal and weather-related trail closures on trails that do not meet standards for all-season use could improve the trail condition, having beneficial, direct and indirect effects on the quality of the recreational trail experience. However, seasonal and weather-related closures would direct equestrian and bicycle users to roads and system trails that meet standards for year-round use, directly and beneficially affecting these recreational opportunities, especially in the short term.

A seasonal closure of unimproved system trails would reduce the number of encounters of hikers with other users, a beneficial, direct effect for them. The absence of trail-density standards under this alternative is expected to have minimally beneficial to no effects on recreational opportunities or the recreational experience.

c. Alternative 3

Under Alternative 3, up to 400 miles of non-motorized system trail and about 626 miles of road would be closed seasonally, directly and adversely affecting users. This alternative could result in the construction of up to about 60 miles of non-wilderness-related, non-motorized trail. System trails in natural areas would be closed to equestrian use, but left open to hiking, with a direct, adverse effect on horseback riding opportunities in these areas and direct, beneficial effects for hikers.

Of all the alternatives, Alternative 3 would manage the fewest miles of system trail with annual seasonal closures and weather-related closures, resulting in adverse, direct and indirect effects on trail users. This alternative would eliminate opportunities for ATV and OHM use, having a direct, adverse effect on motorized recreational opportunities. It would reduce the total amount of non-motorized trails available, adversely and directly and indirectly affecting all users. Seasonal and weather-related closures would direct equestrian and bicycle users to roads and system trails that meet standards for year-round use, having a direct and beneficial effect on these recreational opportunities, especially in the short term.

A seasonal closure of unimproved system trails would reduce the number of encounters by hikers with other users, a beneficial, direct effect on them. The number of miles of system roads being decommissioned each year is likely to have a direct, adverse effect on the amount of motorized recreation available for licensed vehicle users. The absence of trail-density standards under this alternative is expected to have minimally beneficial to no effects on recreational opportunities or the recreational experience.

d. Alternative 4

Alternative 4 prescribes a probable combination of thinning and shelterwood harvest, resulting in an anticipated low need for permanent roads and the need for some temporary roads. Minerals development could generate the need for temporary access roads to exploration or development sites. These roads would be obliterated upon completion of the activity; they could represent beneficial or adverse, direct and indirect effects on the recreational user, depending on the activity desired. Alternative 4 would be similar to Alternative 2 in trail opportunities and effects, with the exception of possibly opening up additional natural areas for hiker-equestrian-bicycle system trail designation. Expanding system trail opportunities for hikers, equestrians and bicyclists in desirable natural areas would have a direct, beneficial effect on these recreational opportunities.

Under Alternative 4, ATV/OHM use would be allowed on up to 286 miles of motorized trail and on approximately 115 miles of Forest Service level -1 or -2 roads, resulting in beneficial, direct and indirect effects for ATV/OHM users. This action would require the closure of about 115 miles of level -1 or -2 roads to licensed motorized vehicles, directly and adversely affecting use for licensed vehicle users. Opportunities for ATV and OHM use, however, would be greatest under this alternative on system trails and on many miles of Forest Service roads.

Expanding the trail system would have a direct, beneficial effect on opportunities for non-motorized recreation, almost doubling them from the current level. The absence of trail-density standards under this alternative is expected to have minimally beneficial to no effects on recreational opportunities or the recreational experience.

3. Recreational Use of Roads and Trails

There are currently 30 miles of hiker-only trail, an amount that could increase under all alternatives. Under all alternatives, system trails could be closed for resource damage, reconstruction, or for other administrative reasons, resulting in direct, adverse effects on trail users in the short and long terms. Foot-travel is not restricted under any alternative and hikers would share most non-motorized trails with equestrians, the former resulting in beneficial, direct effects on hikers and the latter resulting in adverse, direct effects on hikers.

Under all alternatives, licensed vehicles are allowed on all roads open to the public. Under all alternatives, licensed vehicles would have access to over 2,800 miles of level-3, -4 and -5 roads of all jurisdictions, directly and beneficially affecting these users. During the winter months, native-surface roads (usually level-1 or -2) are closed to motorized vehicles. During most of the year, roads offer inferior experiences for non-motorized users and serve primarily as connector routes, a direct, adverse effect on non-motorized users.

Under all alternatives, occasional prohibited use with motorized vehicles is anticipated. Unauthorized use could cause resource damage and create unwanted noise, having a direct, adverse effect on other recreational experiences.

Under all alternatives, the number of commercial and non-commercial special-use permits is expected to increase somewhat during the next ten years. Privately owned equestrian camps in proximity to the Forest are required to have a special-use permit to offer outfitting or guiding services or hold recreational events. Total use, however, is not expected to rise appreciably as a result. Both commercial and non-commercial special use is expected to have beneficial, direct and indirect effects on participating recreational users, and minimal to no effect on others.

As is displayed in Table 3-54, under Alternative 1, ATV/OHM use is expected to be about the same as equestrian use. Bicycle use is restricted to roads and ATV/OHM trails. Since bicycles already are allowed on roads, use is anticipated to increase only 20 percent from the current level with the additional 87 miles of new ATV/OHM trail-connections between roads.

Alternatives 2, 3 and 4 would restrict horses to roads and system trails and eliminate user-developed trails. This is not anticipated to reduce the level of equestrian use; rather, it is expected to redistribute current use to system trails and roads. Under Alternative 2, equestrian use is expected to be about 20 percent less than under Alternative 1, due to some seasonal trail-closures. Recreational ATV/OHM use is prohibited under Alternative 2, except for administrative and permitted use and is expected to be similar to Alternative 3. Bicycle use is expected to be about the same as equestrian use under Alternative 1, with the ability to ride on trails and roads.

Table 3-54. Estimated Forest visits for the year 2015 by alternative.*

		NVUM*	Current use Projected to 2015	Alt. 1	Alt. 2	Alt. 3	Alt. 4
Non-local Use	Visits	176,657	203,156	203,156	203,156	199,889	203,156
Local Use	Visits	345,748	345,748	345,748	345,748	335,566	345,748
Equestrian Use	Visits	47,970	52,884	52,884	42,307	42,307	52,884
ATV/OHM Use	Visits	1,755	1,952	44,501	1,952	1,952	44,501
Bicycle Use	Visits	12,870	14,318	17,182	39,556	39,556	44,501
Total	Visits	585,000	618,058	663,471	632,719	619,270	690,790
% Difference from Alternative 1					+2%	-6%	+4%

*September 2004 update of visitor-use spreadsheet created by Michigan State University based on 2002 national visitor-use survey.

Under Alternatives 2 and 3, the level of equestrian use is expected to be less than under Alternative 1 by about 20 percent, due to seasonal and weather-related closures on trails and native-surface roads. The management emphasis of Alternatives 1, 2 and 4 would be to retain and/or restore the oak-hickory forest-type, thereby maintaining or increasing biodiversity and the attractiveness of the landscape. Alternative 3 has the lowest estimate of recreational use because it envisions fewer trails (400 miles instead of 700) and results in reduced hunting and wildlife viewing opportunities over time as the amount of oak-hickory forest-type declines and species-diversity decreases.

Under Alternative 4, the level of equestrian use is expected to be about the same as under Alternative 1 without seasonal trail closures. Horses would be restricted to trails; however, possible non-motorized trail miles would double from Alternative 1. Bicycle use is expected to be at about the same level as equestrian use under Alternatives 2 and 3, less 10 percent to reflect seasonal trail and road closures. (Trails would not be closed seasonally or for weather conditions under Alternatives 1 and 4.) Increases in use would be higher than Alternative 1 under Alternatives 2, 3 and 4, with their allowance of multiple-use trails.

a. Alternative 1

Alternative 1 offers the most opportunities year-round for horseback riding, with three-quarters of the Forest available for cross-country riding, and up to an estimated 1,000 miles of system or user-developed trails and 458 miles of Forest system level-1 and -2 roads, most with native surfaces. Degraded resource conditions from cross-country riding and the poor condition of some user-developed trails, however, could have a direct, adverse effect on the recreational experience for non-motorized users.

Up to 286 miles of ATV/OHM system trails are envisioned, with reconstruction of about 70 miles of hiker-equestrian trail and about 130 miles of new trail. One week prior to the beginning of firearms season for deer hunting through the closing day of each season, ATV/OHM*s* would be allowed on Forest Service roads, a direct, beneficial effect for these users. Allowing ATVs and OHMs on system roads could create safety problems with other licensed motorized vehicles. ATV/OHM-related injuries are a possibility from collisions on motorized trails between machines and/or with horseback riders, bicyclists or hikers. Road and trail yield signs would be posted to increase awareness of the rights-of-way on shared trails and roads; however, with the high numbers of motorized users anticipated and the differences of speeds traveled, occasional collisions are possible. In addition, allowing ATV/OHM use would have a direct, adverse effect on the experiences of non-motorized users (horseback riders, bicyclists and hikers), increasing the complexity of encounters and increasing the noise level while on or near the motorized trail or road corridor.

Bicycle use would be allowed on motorized, system trails and open roads, with a directly beneficial effect on these recreational users by increasing the numbers of miles available from current levels.

b. Alternative 2

Under Alternative 2, it is envisioned that horses and bicycles could be allowed on up to about 700 miles of non-motorized system trails. In addition, they would be allowed on all roads that are open to public motorized traffic. Horseback riding cross-country, on user-developed trails, or on roads closed to public motorized traffic would not be allowed. In addition, trails that are not constructed to accommodate horse use year-round could be closed during the winter season and in inclement weather. Altering current, recreational, equestrian use-patterns could cause an inconvenience, an adverse, direct effect on equestrian users. Restricting equestrians to system trails would impose a loss of freedom to ride anywhere desired and the possible closure of favorite trails. Conversely, these changes could be viewed as beneficial for the experiences of other users.

Bicycles would be allowed on open system trails and roads, expanding the opportunities for this recreational activity and having a direct, beneficial effect on these users. Allowing bicycles on system trails could increase the complexity of recreational encounters with different user-groups. This is accomplished successfully on many national forests through the use of proper signing and etiquette and is not expected to diminish the recreational experience for hikers or horseback riders. Eliminating cross-country equestrian use, and use on non-system trails and on roads closed to public motorized use would improve the recreational experience of non-motorized recreational users, a direct, beneficial effect. Recreational ATV/OHM use would not be allowed, resulting in an adverse, direct effect on these users. Hunters would be unable to hunt using ATVs, an adverse effect on this user group.

c. Alternative 3

Under Alternative 3, non-motorized users would share system trails, having the same effects as described under Alternative 2. However, a maximum of 450 non-motorized system trail miles would be allowed, reducing available miles of riding opportunities for horseback riders and bicyclists. Weather-related closures would be mandatory rather than optional. With fewer system trail-miles, seasonal and weather-related trail closures and other restrictions, this alternative would reduce horseback-riding opportunities, having the greatest, direct, adverse effects on these recreational users. ATV/OHM use would also be prohibited under this alternative, having about the same effect as under Alternative 2.

d. Alternative 4

Alternative 4 is similar to Alternative 2 regarding non-motorized use and its effects, envisioning about 700 miles of non-system trail. ATV and OHM use would also be allowed on up to 286 miles of motorized trail, as under Alternative 1, and on system roads during firearm deer-hunting season and on up to 229 miles of system road that would be closed to licensed, motorized vehicles. This alternative would offer the maximum miles of trail and road for ATV/OHM use, but would decrease the miles of road available for recreational users using licensed vehicles, with effects similar to Alternative 2. It would offer the most opportunities for bicycle-use, a beneficial, direct effect on these users. It offers more opportunities for horseback riding than Alternatives 2 and 3, but not as many as Alternative 1, a direct, beneficial effect. Hunters may access locations for hunting, but would not be able to ride ATV*s* cross-country to retrieve their game, a direct, adverse effect on these recreational users.

Trail etiquette and proper signing would reduce safety concerns; however, due to differences in speed traveled between licensed vehicles and ATVs/OHMs, and between ATVs/OHMs and horseback riders, bicyclists and hikers, occasional collisions are anticipated, potentially serious, direct, adverse effects. Mud, erosion, widening, trail-braiding or other poor conditions on or along system trails would have a direct, adverse effect on the recreational experience for all non-motorized recreational users.

4. Dispersed Recreational Use

Most non-trail-related recreational activities are expected to remain the same under all alternatives, with the exception of a decrease in the long term under Alternative 3 in wildlife-related uses, such as hunting. The projected succession of the oak-hickory forest-type to the less biologically diverse beech-maple forest-type would result in the long term in a decrease in wildlife- and nature-based recreational uses, having an indirect, adverse effect on these recreational activities.

Under all alternatives, there are general forest areas smaller than 1,500 acres that are managed for non-motorized recreation. However, the presence of access roads into these areas places them in the ROS objective for roaded natural. Each alterantive would offer opportunities for non-motorized experiences, with Alternative 3 offering the most and Alternative 4 the least (Table 3-55). Non-motorized settings can offer an opportunity for visitors to interact without the disturbance of motorized vehicles within an area, even though the sight and sound of motorized vehicles may be experienced from adjacent areas, direct, beneficial effects on these users.

Table 3-55. ROS class objectives in acres by alternative.

ROS Classes	Existing Inventory Meeting Criteria	Alternative 1 MA (Acres)	Alternative 2 MA (Acres)	Alternative 3 MA (Acres)	Alternative 4 MA (Acres)
Primitive	0	0	0	0	0
Semi-Primitive Non-motorized	5,576 acres	WD, RW (31,800)	WD (28,100)	WD (28,100)	WD (28,100)
Non-motorized[1]	0	NM (3,700)	NM (6,900)	NM (11,700)	0
Semi-Primitive Motorized	6,078 acres	0	6.6 (5,700)[2]	0	0
Roaded-Natural (Includes the remaining MAs)	271,348 acres	240,600	235,400	236,300	248,000
Rural	1,605 acres	50% DR, RA (8,500)	50% DR,RA (8,500)	50% DR,RA (8,500)	50% DR,RA (8,500)
Urban	0	0	0	0	0
Percentage of total acreage managed for a non-motorized objective	11	12	12	14	10

[1] Non-motorized is Forest-designated ROS subclass of Semi-primitive Non-motorized. It retains all class criteria except core area may be 1,000 acres and there are no limitations on number of parties encountered per day.
[2] This acreage includes the Burke Branch area.

Management activities within each management area will be consistent with the desired ROS class objectives for the area. Most areas on the Forest are managed with the ROS class of roaded natural. Table 3-55 displays the numbers of acres managed for the desired ROS objectives.

5. Developed Recreational Site Use

Under all alternatives, most of the existing developed recreational areas over 25 years old are in need of assessment of current and future uses and, if applicable, in need of replacement or major repair. Currently, recreational facilities meet critical Forest Service National Quality Standards for health and cleanliness, resource setting, safety and security and responsiveness.

In the absence of budget increases and with continued use, the condition of some of these older recreational facilities would continue to decline, placing at risk the safety and enjoyment of our visitors. In the past ten years, portions of developed recreational areas have been closed due to low use and dilapidated facilities. Closure due to low use, condition of facilities, or for resource protection can occur under any alternative, affecting the displaced visitor. For developed recreational areas with low use, closure or alternative use would not affect overall recreational use. If high-use sites should be closed or services changed, it could displace many of the 585,000 visitors who visit developed recreational areas. Upgrading a recreational area, however, would likely improve services, having a direct effect on recreational experiences at that site.

Campsite occupancy is very low, around 11 percent of total potential use. This is likely due to inadequate infrastructure and amenities, such as electric hook-ups and showers, to meet the needs of campers today. It may also be due to the presence of adequate camping facilities and amenities on nearby private, state, or municipal lands. Camping in developed recreational areas would likely continue to decline without appropriate upgrading. Upgrades, closures or alternative uses may be considered to respond to trends in the changes in camping (USDA Forest Service, 2003c).

Under Alternative 1, construction of new recreational areas would not be allowed, unlike Alternatives 2, 3 and 4, which allow such construction. Any new developed recreational site would be consistent with the ROS class for that site and would not be expected to have a direct or indirect effect on the amount or quality of recreation under any alternative.

6. Timber Harvest

a. Alternatives 1, 2 and 4

Timber harvesting could occur under Alternatives 1, 2 and 4 within developed recreational areas to achieve a recreational or ecosystem objective. Harvesting could occur to create desired forest conditions, promote favorable conditions for large trees, reduce heavily shaded campsites and picnic areas, or to create or maintain vistas, wildlife or plant habitat. In management areas classified as unsuitable for timber production, harvesting methods could be implemented to achieve ecosystem objectives. Harvesting trees within these parameters would have direct effects on recreation in the short term in terms of the visibility of stumps and landings. Visual-quality objectives and mitigation measures would reduce these effects. In the long term, however, harvesting trees in these areas could have a direct, beneficial effect on recreation, opening up views and increasing wildlife and plant diversity.

With the uneven-aged management under Alternative 1, group selection would harvest small groups of trees up to about one-half acre in size, and would not be as visible to the recreational user. In management areas suitable for timber production, under Alternative 4, and in the interior, forested areas under Alternative 2, some mature trees would remain after the final cut. Under Alternative 2, within the suitable timber areas and outside of the interior areas, the mature trees would be removed after successful establishment of the younger forest, usually within 10-20 years. Timber harvesting would likely disrupt recreational activities in the harvest area during and shortly following the harvest. For about the first 15 years, the harvest areas could be difficult to walk through, unless following a maintained trail or road.

The absence of large trees on areas managed as even-aged hardwood forest under Alternative 2 could adversely affect the recreational experience of those desiring to view large, mature trees and forests. Under Alternative 4, large trees would remain in the overstory, offering occasional shade. In non-native pine stands, shelterwood with reserves would be used, leaving the largest pine trees while growing native hardwoods in the understory. Opportunities for hunting and wildlife viewing would increase with the growth of the oak-hickory forest-type, having a beneficial, indirect effect on these uses. In the long term, restoring the oak-hickory forest-type and maintaining the natural areas would improve the ecological integrity of natural areas, having an indirect effect on recreation.

b. Alternative 3

Under Alternative 3 no harvesting would occur except for the maintenance of habitat for threatened and endangered species, and for safety in recreational areas. This would result in large trees becoming larger, offering a greater amount of shade than the other alternatives, but would offer less diversity of plants and wildlife in the long term. The loss of wildlife habitat in the long term could have an adverse, indirect effect on hunting and other wildlife-related recreation activities.

7. Vegetation Treatments

The effects of vegetation treatments under Alternatives 1, 2 and 4 would be very local in nature and would not affect most recreational users in the short term. Under Alternative 3, vegetation treatments would not be used except to maintain habitat for threatened and endangered species. Since vegetation treatments aid in the restoration and maintenance of natural areas and the oak-hickory forest-type, the eventual loss of species diversity could adversely affect some recreational users.

8. Fire Management

Fire management would indirectly affect recreation in the short and long terms under all alternatives—beneficially for some and adversely for others—by maintaining habitats and removing hazardous fuel conditions. Over several decades, natural fuels accumulate in the understory of a forest, creating high-risk conditions that could cause a catastrophic wildfire. Fire management not only reduces the risk of wildfires, but also supports the restoration and maintenance of natural areas and the oak-hickory forest-type.

9. Integrated Pest Management

Integrated pest management activities could have localized and adverse effects in the short term on a few recreational users. The reduction or elimination of non-native plant and animal species would benefit the enjoyment of recreational users immediately and over time by eliminating the encroachment of non-native invasive species on the habitat of native plants and animals.

Under Alternative 3, integrated pest management would be performed mechanically or manually, but not with pesticides or prescribed fire. Such methods could help reduce or delay the spread of non-native invasive species, but would be less effective, increasing the risks of encroachment on native plant and animal habitat, potentially having an indirect, adverse effect on recreation in the long term.

10. Openings and Openlands Management

Openings and openlands management under Alternatives 1, 2 and 4 would have a direct, beneficial effect on hunting and wildlife watching. Under Alternative 3, there would be no openings or openland-management. Openlands would revert to forest habitat over time, indirectly and adversely affecting some hunting and wildlife viewing opportunities.

11. Aquatic Resource Management

Under all alternatives, aquatic resource management would have direct and indirect, beneficial effects on recreation, generally improving conditions for fishing or wildlife viewing.

12. Minerals Management

Under all alternatives, leasing could occur on federal lands with private reserves; however, stipulations could be applied to minimize adverse effects on visitors. Under Alternative 3, the federal estate would be unavailable for oil and gas leasing and minerals exploration, with the least adverse effects on recreational users. Under Alternatives 1 and 2, leasing and mineral exploration could occur on federal lands. The presence of drilling and mining equipment and the disturbance of vegetation and soil in the immediate area could likely have direct, adverse effects on recreation during the periods of disturbance and recovery. No surface-occupancy under Alternative 4 would result in no surface-disturbing activities on federal land and, thus, would have less adverse effects on recreational users than Alternatives 1 and 2.

13. Land-Ownership Adjustment

Under all alternatives, the effects of land-ownership adjustment could have beneficial, indirect effects on recreation, through the consolidation of wilderness or other lands and through the acquisition of high-quality ecosystems. Purchases and/or exchanges could provide larger acreages for a multitude of recreational activities.

CUMULATIVE EFFECTS ON RECREATION

This discussion of cumulative effects takes into consideration the past, present and reasonably foreseeable future actions specified at the beginning of Chapter 3. Generally speaking, past, present and reasonably foreseeable future actions on privately owned land have had, do have and are expected to have minimal effects on recreation on the Forest. The main exceptions to this are the equestrian campgrounds and privately owned ATV recreational areas located near the Forest. Accordingly, the cumulative effects of the alternatives discussed below generally are related to Forest management and use activities. The present and future recreation resource on the Forest could also be affected by the increased national and regional participation rates for high-amenity camping, bicycling, hiking, visitation of day-use areas to picnic or swim, wildlife-viewing and off-highway vehicle use.

The development of equestrian campgrounds on privately owned land near the Forest has resulted in increased recreational equestrian use in the past decade. The total number of horseback-riders from existing equestrian campgrounds is expected to remain the same or minimally increase in the foreseeable future, especially for visitors from out of state. However, the number of privately owned equestrian campgrounds is not expected to increase significantly.

Additionally, there currently are three known ATV recreational areas on private land near the Forest that could affect recreation on the Forest. These recreational areas, or other future ATV areas, are expected to be generally beneficial by providing an outlet for ATV/OHM riders to enjoy their recreational activities and reduce unauthorized use of the Forest.

Road management is currently occurring and is expected to continue in the future. Road management is associated with recreational site development, timber harvest, mineral extraction, wildlife habitat manipulation and the transportation of goods, services and personnel. About 430 miles of Forest Service roads are currently not receiving annual maintenance and remain open to public vehicular traffic. With anticipated increases in use and management activities, the lack of maintenance on primarily level-1 and -2 roads could compromise visitor safety or resource protection, having a direct effect on recreation. An increase in maintenance frequency would be needed under any alternative implemented for both system roads and trails.

All Alternatives

Considering past, present and reasonably foreseeable future actions, on and off the Forest, implementation of any of the alternatives would result in some level of adverse and/or beneficial cumulative effects on the recreational experience of one or another user. It is anticipated that the overall cumulative effects on the non-motorized dispersed recreational experience would be beneficial, with generally no effect on developed recreational site use.

J. HERITAGE RESOURCES

The Forest contains many sites representing past human occupation and activities. Based on the most current figures, the Forest probably contains over 6,950 heritage-resource sites, of which 5,950 are likely to be eligible for inclusion on the national register of historic places. To date, the heritage program has recorded 2,827 heritage-resource sites. The most visible heritage resources on the Forest include the Mississippi Bluffs Ranger Station and Lincoln Memorial, site of the 1858 Lincoln-Douglas debate, in Jonesboro; Millstone Bluff, an interpreted prehistoric Native American site and trail; and the Illinois Iron Furnace.

The primary mission of the Forest's heritage program is to administer the heritage resources in a spirit of stewardship for the inspiration and benefit of present and future generations. Heritage resources are important, non-renewable resources that require inventory, evaluation, protection and interpretation. They are recognized as being fragile and irreplaceable and represent important aspects of our nation's prehistoric and historic cultural heritage. As such, interpretation of heritage resources for the public is another important aspect of heritage-resource management. The goals of the program are threefold:

- To locate the historic and prehistoric heritage resources within the Forest's boundaries (inventory)
- To determine the eligibility of these resources for inclusion on the National Register of Historic Places (evaluation)
- To preserve and protect those resources (protection and interpretation).

Section 106 of the National Historic Preservation Act (NHPA) requires all land-managing federal agencies to consider heritage resources, including both archaeological and historical sites, when planning earth-disturbing activities. NEPA also requires the federal government to plan programs and projects in order to "preserve important historic, cultural and natural aspects of our nation's heritage."

DIRECT AND INDIRECT EFFECTS ON HERITAGE RESOURCES

Direct effects on historic properties can result from both natural and humanly-induced earth-disturbing activities, including soil disturbance to varying depths; soil compaction or rutting; artifact alteration through prescribed fire; the alteration of a site's immediate or adjacent cultural and physical setting, such as by the addition of inappropriate visual or auditory elements; and land-use changes, such as exchanging land away from protection under federal historic preservation laws. Indirect effects to historic properties could include looting or vandalism due to increased access or use, or site degradation as a result of an off-site project or construction of roads or trails.

Several types of ground-disturbing, land-management activities that vary in size (miles or acres) have the potential to affect heritage resources. These include recreation and aquatic resources management, fire management, vegetation treatments, wildlife management, road construction and maintenance, facility management (building and structure maintenance), land-use changes (land exchange and special-use permits) and minerals management. Any of these activities could directly affect unknown significant heritage resources.

1. Restrictive Management

No effects are anticipated under any of the alternatives.

2. Roads and Trails Management

Under all alternatives, road construction could directly affect unknown sites, depending on variables specific to each portion of construction. Soil could be removed containing cultural deposits and artifacts could be damaged. Where fill is added, heritage resources could be buried deeper. This could protect a site from compaction or rutting, while at the same time essentially precluding additional scientific study using conventional technology. Construction could lead indirectly to the erosion of heritage resources and the resulting artifact exposure could promote site-looting and vandalism.

Maintenance or reconstruction of existing roads presents less potential for direct effects on intact archaeological sites because damage to an unknown site likely would have occurred during the original construction (if before 1966 and enactment of the National Historic Preservation Act).

3. Recreational Use of Trails and Roads

Under all alternatives, direct effects to significant heritage resources can result from the installation or expansion of recreation facilities already present and in use. Indirect effects could include soil erosion and compaction of heritage resources due to visitor use and access to some areas could result in archaeological vandalism. These indirect effects can occur with illegal or unplanned expansion of established or designated recreation areas or trails. While historical properties located in recreation areas and along designated trails and road corridors can be signed, monitored, patrolled and protected, impacts to heritage resources outside of these areas are largely uncontrolled. This is especially true of unauthorized ATV/OHM use.

4. Dispersed Recreational Use

Dispersed recreational activities under all alternatives provide some of the highest potential to affect heritage sites. Most of the Forest is open to dispersed non-motorized activities such as hiking, hunting, bird-watching, backpacking, camping and horseback-riding. Heritage resources are especially vulnerable to dispersed recreational use because modern-day humans are attracted to the same landscapes as were Native Americans and early Euro-American settlers. Currently, popular dispersed camping areas are concentrated where prehistoric and historic-era camping-areas were located. Easily traversed landscape-routes such as trails and roads have been used repetitively over hundreds of years. Therefore, there is a high potential for direct effects to heritage resources from dispersed recreational use. These effects include soil-compaction from increased hiking or equestrian-use and artifact displacement and damage from heavy activity. Possible indirect effects include vandalism and/or looting.

5. Developed Recreational Site Use

It is possible that construction of new facilities under all alternatives could directly affect an unknown significant prehistoric or historic property. In most cases of concrete slab or footing construction, disturbance may extend into or below soil containing archaeological deposits. Pier foundations may also extend into or through intact cultural deposits. The construction of structures could also directly affect significant heritage resources by introducing inappropriate architectural or other visual elements that do not fit within the historical context of the affected property. This diminishes the integrity and the significance of the historic property. Indirect effects could include erosion or vandalism of significant heritage resources facilitated by public access.

6. Timber Harvest

Under all alternatives, the analysis and mitigation of timber-harvest activities would reasonably ensure no effects on heritage resources.

7. Vegetation Treatments

No effects are anticipated under any of the alternatives.

8. Fire Management

Heritage resources could be directly and indirectly affected under all alternatives by heat damage and site-erosion resulting from wildland fires or fires ignited to suppress or control wildland fires. High-temperature wildfires could directly affect heritage resources by damaging archaeological sites located on or near the ground surface, standing structures, or grave-markers. Heritage resources from the historic period are most subject to damage by wildfire because many of these properties are more likely to include surface artifacts, having been deposited more recently.
Studies show that wildfire and, in some cases, high-temperature prescribed fire, may alter the character and condition of surface artifacts, for example, by melting glass, "crazing" lithic and ceramic artifacts and burning wooden structures. Low-temperature prescribed fire could similarly and directly affect surface sites and very shallow deposits and artifacts; but, due to the lower temperatures, the effects would be to a much lesser degree than those from wildfire. However, wooden structures and cemetery markers could still be damaged, as could surface artifacts.

Prescribed fire on the Forest is generally of low intensity and duration. With few exceptions, prescribed fires will not burn hot enough to reach mineral soil or scorch the ground. Temperatures are typically not sufficient to cause heat alteration, exfoliation, or other damage to stone, concrete, mortar, or glass, metal and ceramic artifacts. Given its typical low intensity, prescribed fire is not expected to adversely affect prehistoric or historic sites that do not contain aboveground combustible elements. The principal exception to this is fire in areas of high fuel buildup. In such situations, artifacts and non-combustible aboveground features could be damaged by fire.

Fire-lines installed with tractor-plows could directly affect heritage resources by physically displacing artifacts located on or near the ground surface. The displacement would be primarily lateral, as the plow folds soil and artifacts to each side of the fire-line. When multiple parallel fire-lines are used for fire control, it would be possible to disturb a large portion of a small site. Fire-lines established using a disc harrow would have less effect since lateral soil-displacement would be minimal; but some fragile surface artifacts could be broken. Effects from fire-lines constructed with heavy equipment would be the most severe.

Fire-lines installed for prescribed burns are less likely to directly or indirectly affect heritage resources, since the fire-lines of prescribed burns are inventoried and field-surveyed for the presence of heritage resources prior to implementation of the burn. Since heritage surveys cannot precede emergency fire-line construction, there is a high potential for unknown properties to be affected by wildland fire suppression.

Indirect effects of fire-line installation and burning could include some erosion losses from the removal or burning of vegetation, or deterioration of artifact- or feature-condition following damage by high temperatures.

9. Integrated Pest Management

No effects are anticipated under any of the alternatives.

10. Openings and Openlands Management

Since no construction of wildlife openings or openlands would occur under Alternatives 1, 2 or 4 before field surveys and inventories are conducted, direct effects on heritage resources are not likely. Once openings and openlands are established, routine maintenance such as disking and mowing would have minimal indirect effects. No openings or openlands would be allowed under Alternative 3.

11. Aquatic Resource Management

Construction of streambank stabilization projects could potentially affect heritage resources under all alternatives. However, since no construction would occur before field surveys and inventories are conducted; direct effects on heritage resources are not likely. No indirect effects are anticipated.

12. Minerals Management

Under Alternatives 1, 2 and 4, the exploration for and development of leasable minerals, oil and gas could affect heritage resources through access-road construction, pipeline construction, well-pad placement and the removal and displacement of minerals and soil. However, since none of these activities would occur before field surveys and inventories are conducted; direct effects on heritage resources are not likely. Indirect effects are not anticipated. No minerals management is anticipated under Alternative 3.

13. Land-Ownership Adjustment

Under all alternatives, the exchange of federal land containing significant heritage resources to non-federal ownership is considered a direct effect with no indirect or cumulative effects. This is because protection under federal laws and guidelines would no longer apply to the resources. However, such transfers of heritage resources would be coordinated with the State Historic Preservation Officer in order to prevent adverse effects.

CUMULATIVE EFFECTS ON HERITAGE RESOURCES

This discussion of cumulative effects takes into consideration the past, present and reasonably foreseeable future actions specified at the beginning of Chapter 3. Considering these past, present and reasonably foreseeable future actions, both on and off the Forest, the cumulative effects on heritage resources from all management and use activities under any alternative are expected to be minimal to non-existent, due to field inventory, evaluation, and protection and mitigation measures implemented prior to project-related activities. Natural processes such as weathering, erosion and wildfire could have adverse, direct and indirect, cumulative effects on sites and artifacts over time.

K. VISUAL QUALITY

The Forest is one of the only large areas of forested land in Illinois. Its visual character is that of pleasant spatial contrast between large and small islands of trees and the surrounding, generally privately owned, open land. The privately owned land around the Forest is a mix of pasture, cropland and woodlots; barns, houses, ponds, fences and other cultural disturbances are apparent. Evidence of past mining and other industrial uses can be observed to a lesser extent. The typical visual character of the Forest is natural-appearing, but the overall character of southern Illinois is dominated by the uses on privately-0wned land.

The area has many natural features. The bluff regions of the Ohio and Mississippi Rivers have broken topography dominated by high cliffs, wetlands and floodplains. There are natural bridges, caves and the massive rock formations of Garden of the Gods.

The system of classifying visual quality on the Forest involves the use of a visual quality inventory. This inventory measures the amount of change from a natural-appearing condition. The four, inventoried, visual-quality objectives are preservation, retention, partial retention and modification.

Many activities that occur on the Forest are visually apparent. These include timber harvest, road and trail construction, minerals operations, recreational site-development and use and wildlife habitat improvements such as ponds and openings. Lack of maintenance on roads, trails and facilities and lack of vegetation-management activities can also affect the visual resource, sometimes as much as or more than active management activities.

Hardwood tree species are predominant on the Forest, with the oak and hickory being the most prevalent. There are also about 45,000 acres of non-native pine plantations—obviously not part of the natural landscape—distributed mostly across the eastern half of the Forest.

An adverse visual condition has prevailed over several decades in un-thinned pine-stands within developed recreational areas and along visually-sensitive travel corridors. Some of the most visited developed recreational sites with this condition are Garden of the Gods, Rim Rock, Pine Ridge campground, Lake Glendale, Pine Hills campground, Teal Pond, Red Bud, Lake Tecumseh and Whoopie Cat Lake. These pine-stands typically are overstocked with tall, lanky, small-crowned trees and have low visual penetration. Although they offer some visual variety with respect to color and texture, they are not as visually attractive as the native hardwoods. Additionally, they are often subject to winter storm damage and, in recreation areas, may become dangerous to the visiting public as the trees begin to die. In fact, the ultimate fate of these stands is a mortality that likely will occur all at once for much of the trees since all are of uniform age. The eventual large-scale die-off likely will bring about a dramatic visual-character change.

DIRECT AND INDIRECT EFFECTS ON VISUAL QUALITY

1. Restrictive Management

a. Filter-Strip Management

The corridor of trees left in the filter-strips would mitigate or soften visual contrasts caused by nearby timber harvesting. Narrow filter strips along intermittent streams would appear as sparse stands of trees in shelterwood-cut areas, only minimally reducing the visual contrast of harvest-openings on either side. The visual effect would be that of one larger opening. Along perennial streams, the filter strip would effectively divide the harvest units, thereby creating the perception of two separate openings.

When cutting is allowed in filter strips for non-timber objectives, as might occur under Alternatives 1, 2 and 4, the degree of visual contrast depends on the amount of canopy remaining and the width of the filter strip. Neither group nor single-tree selection would substantially affect the visual character of the remaining corridor of trees.

b. Candidate Wild and Scenic Rivers

The objective of the Candidate Wild and Scenic Rivers management prescription is to maintain or enhance the natural characteristics of the corridors that led to their recommendation. Under all alternatives, each of these stream corridors would have the "retention" visual-quality objective—management activities not evident. All six stream-corridors have high visual-sensitivity levels and high landscape-character values. Each corridor would be managed for at least the “retention” visual-quality objective even if not designated a wild and scenic river.

c. Wilderness Management

Under all alternatives, the visual-quality objective for wilderness and wilderness-study management areas is Preservation—only ecological changes would occur. Within these management areas there would be no timber harvest or other vegetation treatments, except for the benefit of native plant communities, watershed improvement and/or wildlife habitat. Such activities would meet at least the "retention" visual-quality objective. These practices would result in visual effects in the short term; but, within one growing season, would be undetectable. In areas close to trails or other commonly-visited areas, burning could be limited to spring when recovery is the quickest.

2. Roads and Trails Management

Under all alternatives, lack of maintenance, reconstruction and closures of roads and trails could have an adverse effect on the visual resource. The maintenance of roads and trails to Forest Service standards would avoid adverse effects on the visual resource. When proper maintenance is not performed, road or trail closures may be needed to prevent resource damage and adverse effects on the visual resource.

Trails and roads leading into developed recreational and special interest areas with a visual-quality objective of “retention” would be maintained unobtrusively.

Alternatives 1, 2 and 4 include road and trail construction or reconstruction. Site-specific planning and design of transportation facilities would include mitigation measures to visually integrate them with the environment at each site, although effects on the visual resource are likely in the short term. Alternative 3 allows only minimal road construction for administrative purposes and, therefore, would have less effect on the visual resource.

3. Recreational Use of Trails and Roads

Equestrian and ATV/OHM use has the potential to adversely affect visual quality if the travelways are poorly designed, located and/or maintained. This is especially true with regard to user-developed trails, whether for equestrian or ATV/OHM use. Use of poorly-designed, located and/or maintained trails and roads can result in rutting, gullies, soil erosion, braiding of trails, damage to vegetation and littering. All of these consequences can have adverse effects on the visual resource. However, changes that reduce visual quality on designated routes can be mitigated with proper trail construction, maintenance and management. The use of large four-wheel-drive off-road licensed vehicles on low-maintenance roads during wet weather can also adversely affect the visual resource when the roads are left in an unsightly condition.

Alternative 1 allows cross-country equestrian use to continue, as well as the use of user-developed trails dating to 1992. It could result in the creation over time of additional user-developed trails. Adverse visual effects are caused by poor trail location and the lack of trail maintenance on these user-developed trails. Up to 286 miles of ATV/OHM travelways would be allowed within corridors identified on the 1992 Plan’s trail corridor map.

Under Alternative 2, equestrian use is allowed only on designated system trails. Alternative 4 allows the up-to-286-miles of ATV/OHM travelways identified on the 1992 Plan trail corridor map, as well as up to 50 percent of maintenance level 1 and 2 roads. Alternatives 1, 2 and 4 are not expected to have adverse effects on the visual resource if adequate maintenance is performed. Alternatives 2 and 3 prohibit ATV/OHM use; consequently, no effects on the visual resource could occur.

Under all alternatives, unauthorized ATV/OHM use can affect the visual resource. When people ride ATV/OHMs where use in not allowed, effects could be similar to the adverse effects of user-developed trails.

4. Dispersed Recreational Use

Under all alternatives, dispersed recreational uses generally would have minimal effect on the visual resource unless over-use or unauthorized activities—such as littering or vandalism—occur at a particular site.

5. Developed Recreational Site Use

Camping, swimming, picnicking and hiking are recreation activities that are often dependent on facilities that require maintenance and periodic replacement. The appearance and functionality of the facilities can add to or detract from the recreational experience. Therefore, the visual appeal of the developed recreational sites is dependent on the level of upkeep of the facilities. As funding levels for operation and maintenance have decreased over time, so the condition of the facilities has diminished. Some facilities have exceeded their maintenance life-cycle and require replacement or removal.

These issues have been addressed and proposals offered in the "Developed Recreation Master Plan for the Shawnee National Forest," December 29, 2003. The intended outcome of this master plan is to improve the visitor's total experience at the Forest's recreational sites, maintaining scenic integrity and the visual appeal of the sites. These recreation management actions could occur under any alternative and would generally only have beneficial effects on the visual resource.

6. Timber Harvest

a. Effects Common to All Harvest Methods

All cutting methods create effects that are visually evident, at least in the short term (up to five years). Short-term visual effects include the following, in order of ascending magnitude: color and textural contrasts associated with exposed soil from skid trails and log landings; the presence of slash; and the growth of new vegetation. Standards and guidelines designed to mitigate the visual effects of harvest would be employed.

Long-term visual effects are a result of the contrasts associated with the size and scale of newly created openings and the type of vegetation on the site. The degree of severity of these types of contrasts and the length of time that they remain evident is related to the perception of change from an existing landscape character. For example, the greater chance of unpleasant visual contrast occurs with larger openings. The visual effects associated with even-aged timber harvest may last more than 20 years. The visual contrasts by silvicultural methods are listed in descending order: clearcutting, shelterwood, group selection and single-tree selection.

Timber harvest conducted under the uneven-aged management system would, in combination with the appropriate mitigation measures, complement the more visually sensitive landscape settings. Group-selection cutting mimics natural openings (2,200 to 26,000 square feet) even in heavily forested areas. Single-tree selection provides low visual contrast because the residual canopy maintains the appearance of a forested landscape. Because these latter two harvest methods provide low visual contrasts over both the short and long term, they can meet each of the visual quality objectives up to and including "retention."

b. Even-Aged Silvicultural System

i. Clearcutting

Clearcutting would cause the greatest visual contrast of all silvicultural practices. Large harvest openings create greater visual contrast. Therefore, this cutting method would usually be limited to clearing areas that have been heavily damaged by natural forces, or to deal with insect and disease infestations. Even in these areas, appropriate mitigation measures would help lessen the visual impact of the openings. (See visual-resource guidelines, Appendix F of the Forest Plan). Although the harvest units may be as large as 40 acres, clumps of wildlife den-trees and filter strips left for protection of streams would provide some forest-cover and visually break the harvest area into smaller units of viewed openings.

ii. Shelterwood or Shelterwood with Reserves

Alternatives 2 and 4 each allow a different method of shelterwood cutting. The standard shelterwood method involves removal of the final forest overstory following one or more preparatory cuts in order to improve tree-regeneration in the forest understory. This method has the appearance of a thinning until the final overstory is removed. When the overstory is removed after 10 to 20 years the cut area would closely resemble a regenerating clearcut of equal age and size.

The other method, allowed primarily under Alternative 4 and in pine stands, is referred to as shelterwood with reserves. This technique is favored in areas where visual sensitivity is a concern because the final removal cut can be delayed or forgone indefinitely. The visual benefit of this technique is the maintenance of the appearance of a forested area and the reduction of visual contrast. Both methods would be employed under Alternative 2, with shelterwood with reserves being utilized primarily on ridge-tops and upper slopes within the forest interior blocks.

The proposed management for conversion of pine plantations to native hardwoods is the shelterwood-with-reserves harvest, which would promote a transition over time to native hardwood species. Alternatives 1, 2 and 4 would provide a way to deal with the present visual problem of pine stands and also the potential future visual problem when the pine stands begin to die off. Allowing appropriate timber management options to achieve a more visually desirable stand-composition would be required to accomplish the overall objective. Since Alternative 3 does not allow commercial timber sales and supports the visual-quality objective of preservation, this alternative would not allow the resolution of this condition and, ultimately, would contribute to a potential reduction of visual quality in visually sensitive areas.

c. Uneven-Aged Silvicultural System

i. Group Selection

The randomly-distributed, 2,200-to-26,000-square-foot harvests proposed under Alternative 1 would mimic the openings that occur in a forest as a result of natural mortality. Even though slash would be present, the amount of slash generated by group selection will be similar to the amount of deadfall in naturally-occurring openings. This cutting method would have low visual contrast and be designed with appropriate mitigation measures to meet all visual-quality objectives up to and including retention.

ii. Single-Tree Selection

This practice leaves the greatest amount of forest canopy of all cutting methods. This results in low visual contrasts and the least change in landscape character. Forest visitors would see a slight change in vegetative density, but the resulting characteristics of this method would closely resemble the original forested condition, regardless of the seasonal changes in visual penetration. Mitigation measures that deal with slash treatment would be geared to accommodate the sensitivity levels of individual areas and/or travelways.

7. Vegetation Treatments

a. Tree-Cutting

Tree-cutting would primarily occur in Alternatives 1, 2 and 4. Under Alternative 3, the cutting of trees would normally occur only to protect human health and safety, usually around recreation areas and travelways, or for maintenance of barrens habitat and threatened, endangered and sensitive species in natural areas. (See “Effects Common to All Harvest Methods” in section 6, above. Intermediate cuttings could occur under Alternatives 1, 2 and 4 in both even-aged and uneven-aged silvicultural systems and involve any removal of trees from a stand between the time of its establishment and the harvest cut. Generally, intermediate cuttings include thinning, release and improvement cutting and can be accomplished commercially or non-commercially. Intermediate cuttings would have little effect on the visual resource under any alternative since the forest canopy would remain to continue growth and appropriate mitigation measures would be used.

b. Herbicide Use

This management practice has the potential of creating dramatic and unacceptable visual contrasts, depending on the type and season of application, proximity to the visible areas of visually sensitive travelways and recreational use areas. However, in the case of eradicating non-native invasive species, such as kudzu, for example, the temporary adverse visual effects of brown-out by herbicide-use may be tolerated on a short-term basis in order to manage the larger problem. The direct effect within the first 6-to-12 months would be browning and die-off of vegetation. The long-term effect would be a return to a more natural landscape-character. Spot applications of herbicide on specific plants or plant populations would greatly reduce the visual impact as compared to broadcast applications. Alternative 3 would allow no pesticide use and, therefore, have no effects on the visual resource related to the use of herbicides.

c. Mowing

Mowing would be used for open-land management under Alternatives 1, 2 and 4 and is visually compatible with the management practices of privately owned openlands adjacent to the Forest that are managed for agricultural use. Some mowing would take place under all alternatives as part of the custodial maintenance at developed recreational and administrative sites and would maintain the visual character of these sites.

d. Forest-Interior Management

The management of forest-interior habitat as Forest Interior Management Units under Alternative 1, or with forest-interior blocks under Alternatives 2 and 4, would maintain large, contiguous blocks of canopied forest with a minimum one-mile diameter. Generally, these areas have few, if any, roads or powerlines. This would result in minimal effects on the visual quality of the Forest except to contribute to a natural-appearing character. Alternatives 2 and 4 would actively manage the forest-interior blocks with prescribed fire and some timber harvesting to help maintain the oak-hickory forest type.

8. Fire Management

The immediate visual effect of the use of prescribed fire is that some of the treated area is blackened. The preferred pattern, for vegetative purposes, is to apply a prescribed burn that creates a mosaic of burned and unburned areas, rather than burning an entire area. Visually, these mosaic-patterns can create variety that adds to the appeal of a natural-appearing landscape. In the short term—three to four months—the burned areas would be nearly undetectable as re-growth begins. Prescribed fire temporarily reduces understory vegetation and can maintain open forested conditions with more opportunities for views and vistas. Reduction of undergrowth also creates easier pedestrian access.

Under all alternatives, there would be minimal, adverse effects on visual resources as a result of prescribed fire in the short term, followed by varying degrees of beneficial, indirect effects in the long term that include increased landscape diversity, accessibility and viewing.

Alternative 1 allows up to 3,500 acres of prescribed fire. Alternatives 2 and 4 allow large landscape-scale, prescribed burns of up to 20,000 acres per year. Alternative 3 allows prescribed fire only within natural areas in order to maintain the integrity of desired vegetation components, but would not promote the benefits of prescribed fire for the entire forest in the long term.

The benefits of Alternatives 1, 2 and 4 would include creation of visual variety and increased visual penetration within timber stands in the long term. If larger areas of the forest are burned, as planned under Alternatives 2 and 4, greater visual diversity would result.

9. Integrated Pest Management

a. Non-native Invasive Species Control

With the exception of kudzu, most forest visitors do not visually discern the difference between native and non-native, invasive vegetative species. Furthermore, the scale of the area of treatment to eradicate non-native plant species is generally small in size and is not noticeable to most motorists, with the exception of burnt or browned-out areas. These methods of treatment are generally short-lived and, in the case of burning, are usually scheduled during early spring to be followed shortly thereafter by the seasonal green-up.

Since no pesticide use is allowed under Alternative 3, there would be no visual effects due to herbicide use in the short term. Treatment methods such as hand-pulling, mowing, disking and seeding would be visually perceived as similar to the agricultural practices in southern Illinois.

b. Pesticide-Use

i. Terrestrial

Herbicides, which may be used under Alternatives 1, 2 and 4, have an initial browning phase, an adverse, direct visual effect in the short term. This management practice is used primarily in small, localized spot-treatments and would not cause significant visual concerns, even along travelways. It would not be used extensively in visually sensitive use areas and travel corridors that have a "retention" or "preservation" visual quality objective. Insecticides could be used if required under Alternatives 1, 2 and 4 and would have no effects on the visual resource.

ii. Aquatic

Minimal visual effects would be associated with the use of aquatic pesticides.

10. Openings and Openlands Management

Permanent openings are an obvious human-caused disturbance. The contrasts associated with these openings are derived from their size and shape as well as the color and textural differences of the grasses and forbs of the surrounding forest cover. The most striking contrasts are from the size and shape of the openings. The larger the opening, the greater the visual contrast will be. The contrasts associated with shape are greatest when straight and/or angular configurations are used around the perimeter of the opening. The viewer could relate such openings to private agricultural use.

Compared with Alternatives 2 and 3, Alternatives 1 and 4 would manage more small (one-acre) wildlife openings and all openlands greater than 80 acres in size, which include all past wildlife openings and acquired parcels of land. The magnitude of the direct effect of this management on the visual resource would depend on whether the opening was re-established from a reforested area or from an existing open landscape. There might or might not be a noticeable immediate effect from the re-establishment of a number of small openings, depending on whether they are within areas visible from travelways.
Alternative 2 manages for large openland blocks and wildlife openings, with a lesser number of small openings. The magnitude of the direct effect on the visual resource would depend on whether the opening was re-established from a re-forested area or from an existing open landscape. Alternative 2 would have a lesser impact on the visual resource than Alternatives 1 and 4 because fewer numbers of openlands and openings would be re-established or managed.

Alternative 3 does not manage for openlands and would have a direct, adverse effect on visual quality, different from the others—most openland eventually would become forested, decreasing the visual contrasts on the Forest. Localized or regional landscape contrasts would remain about the same, given the amount of privately owned, generally open, agricultural land in the planning area.

11. Aquatic Resources Management

a. Streambank Stabilization and Restoration

This management practice is expected to produce few, if any significant visual impacts, depending on whether or not the work is done in view of the public. The degree of visual impact would be related directly to the scale of project-work and its orientation to visitor views. Generally, however, these types of projects are small in scale and are done to improve adverse visual conditions. The effects of this practice could be mitigated to complement the existing landscape-character and settings under each alternative.

b. Woody-Debris Management

This management practice would not have any significant visual effects because it either would not be visible above the water surface, or would appear to be natural.

12. Minerals Management

Mineral or energy exploration and development activities have the potential to affect visual quality under all alternatives. Alternatives 1 and 2 identify areas of the Forest where the mineral estate is federally owned and that are suitable for oil, gas and mineral exploration and development. Both alternatives identify some areas as not available for leasing, available for leasing with a no-surface-occupancy stipulation, available for leasing with restricted surface occupancy, available for leasing with special stipulations and available for leasing with standard stipulations.

Alternative 1 would offer units of federal minerals for lease and Alternative 2 would respond to lease requests. The leased area could be as small as 2,000 acres and probably not exceed 80,000 acres. This potential leasing, regardless of the size of area, could lead to the development of two to six exploratory sites. Visual effects would be similar to those noted for group-selection cutting, section 6.c.i, above. Oil and gas exploration can be designed to provide low visual contrast over both the short and long term; consequently, they could meet visual-quality objectives up to and including “retention.”

Alternative 3, with no leasing allowed and Alternative 4, with no surface occupancy, would result in no disturbance of the Forest surface. Under Alternative 4, leasing could occur if the extraction of privately owned minerals leads to the extraction of federally owned minerals. It is not possible to project the possible lease-area under Alternative 4. The Forest surface over privately owned mineral estates could be occupied under both alternatives.

Most energy and mineral activities can be made compatible with the “retention” objective. The potential for conflicts between minerals management and visual quality can be controlled by location and timing, even under standard stipulations. There is limited potential to control the development of privately owned mineral estates; however, negotiations with mineral-estate owners and their representatives would be a priority

If minerals exploration should occur under Alternatives 1 and 2, the "retention" visual-quality objective would be met immediately upon completion of the landscape-disturbing project. That is, evidence of the activities would be substantially unnoticeable to the Forest visitor. This can be accomplished by blending the project area with the surrounding landscape, so that a visitor might believe the area to be a natural part of the landscape.

The potential for exploration and development activities involving privately owned mineral estates beneath the Forest is unknown, so effects cannot be projected. When considering federally owned minerals, the potential for adversely affecting the visual resource would be least under Alternatives 3 and 4 because they do not provide for occupancy of the Forest surface.

Alternative 1 results in a decision to lease and identifies units of federal mineral ownership for leasing. These activities are expected to lead to a small level of visual disturbance associated with exploration (two to six drill sites). Alternative 2 identifies units of the federal mineral estate that are available for leasing, but does not make the decision to lease. Visual disturbance associated with exploration could occur under Alternative 2, but visual-resource impacts would receive site-specific consideration.

Oil and gas operations most likely would occur at small, widely scattered locations. It is improbable that any visible area, whatever its sensitivity level, would have more than one two-and-a-half-acre drilling site.

13. Land-Ownership Adjustment

No effects are anticipated under any alternative.

CUMULATIVE EFFECTS ON VISUAL QUALITY

This discussion of cumulative effects takes into consideration the past, present and reasonably foreseeable future actions specified at the beginning of Chapter 3.

All the past and present actions both on and off the Forest have led to the development of the visual landscape-character that is presently visible in the planning area. (The planning area for visual concerns consists of the visible areas under federal and non-federal ownership. This includes a combination of agricultural, forested and urban settings in southern Illinois.) These actions have had a dramatic impact and change upon the pre-settlement landscape that was predominantly forested in southern Illinois. Land clearing for agriculture, road construction, open pit mining and urban development have had the most dramatic change upon the landscape character in this part of the State. The cumulative effect of these past and present actions has created the existing visual condition. These changes have resulted in a reduction of approximately 67 percent of the pre-settlement landscape forested land within the Forest proclamation boundary. 47,716 acres of pine reforestation was introduced in the early 1940's, which re-introduced 17 percent more forested land. That management action brought the total forested area on federal land to the current 92 percent.

Since the existing federally owned property is 92 percent forested, there is little character change since establishment of the Forest in the 1930's. Regardless of the alternative, there are no foreseeable (50+ years) changes that will take place in the over-all forested landscape character in the long term. An inherent benefit of federal land ownership is the fact that forest management will ensure the perpetuation of the natural-appearing forest character, regardless of tree species, densities or management practices under each alternative. The most noticeable variations of visual quality associated with forest management practices would be on a short-term (one to five years) basis.

The management activities under the alternatives that can have effects on the management activities occurring on national forest land, such as clearcuts, shelterwood final overstory removals and road construction, are visually apparent, human changes in the natural environment. Other management activities not as apparent include recreation developments, small openings created through group-selection timber harvesting that mimic naturally occurring gaps and wildlife habitat improvements (e.g., ponds and small permanent openings).

The purpose of the visual-resource management system on the Forest is to provide management objectives for all national forest lands. These objectives are designed to help land managers avoid or reduce potential adverse visual effects from timber harvesting, road construction, mineral development or other landscape-altering activities.

Visual variety is commonplace in southern Illinois due to the intermingling of private land (cultivated lands and pasture) and national forest land. Therefore, timber harvest to maintain or improve visual variety is unnecessary on the Forest. Conversely, it is the contiguous stands of timber on the Forest that provide most of the visual variety in this part of the state. Exceptions to this general rule include clearings to improve the viewing distances and vistas at or near recreational sites.

Land in the suitable timber base will retain a natural-appearing character, although timber harvest activities may be apparent. Forest visitors seeing harvested areas are likely to notice short term (up to five years), adverse visual effects including color and textural contrasts from the presence of slash, new openings, exposed soil and reduced visual penetration into stands due to new, densely growing vegetation. The most apparent (up to 20 years) visual effect in the long term is the opening created. Clearcuts have the longest-term effect. Shelter-wood is similar to a clearcut but allows regeneration to become established before the remaining trees are removed. Group selection has considerably less effect and singletree harvests have the least effect on the visual resource. However, the total area affected, regardless of harvest technique, is also very important to visual quality. The degree of adverse visual effect is directly related to the amount of harvest activity within a viewshed, as well as the intensity of the change.

The public's visual sensitivity towards or acceptance of timber harvesting is based on changes from a perceived existing natural condition. The best way to compare the existing condition with respect to cumulative future conditions is to compare the amount of acres harvested and the method of harvesting.

Harvest activities will be concentrated on a suitable land base, especially under Alternatives 1, 2 and 4. Therefore, timber harvest will have the potential to be more visually apparent in the areas where harvest is prescribed. Of course, there will be very little visual effect from timber harvest in that part of the forest where timber harvesting is not allowed or is unlikely to occur. The anticipated cumulative effects of the alternative actions on the visual resource are as follows:

1. Alternative 1

Implementation of this alternative will generate about the same level of visual-quality change through timber harvest as the 1992 Plan uses with group selection. Uneven-aged management generates less change in existing landscape character because more trees remain on site. If managed properly, it simulates natural openings created by wind-throw and natural mortality, when considered on an individual-site basis.

2. Alternative 2

Implementation of this alternative will create fewer adverse visual effects than Alternative 1 due to the interim passive management of the Camp Hutchins Area, the removal of the Cave Valley, Ripple Hollow and Burke Branch Areas from the timber base, the increased widths of filter strips, the predominant use of uneven-aged timber management, the changes that would expand the snag and den-tree standards and guidelines and the use of shelterwood and shelterwood-with-reserve harvest methods. These last changes help reduce the apparent size of openings for both even-aged and uneven-aged timber management. The suitable timber-base is about 51 percent of the Forest. Therefore, less of the Forest will be affected by harvest activities than in the past, those lands still suitable will display more adverse visual effects, because the harvest levels are higher and activities will be concentrated on a smaller timber base.

3. Alternative 3

Under Alternative 3, there would be no timber harvest for any reason, no oil and gas leasing activities, no ATV/OHM travel-ways, no wildlife openings and very little prescribed fire. The adverse visual effects associated with no management would be prevalent in the hand-planted pine-stands on the east side of the Forest and would exaggerate the decadent appearance of these stands in the near and distant future (10-50 years). This alternative would also reduce the possibility of visual variety since active timber management creates different dark-light color combinations and greater textural variations through the leaf-on season.

This alternative could have a favorable effect upon those portions of the forest that are presently experiencing a conversion from oak-hickory to a maple timber composition. A higher maple population would provide a more dramatic fall color display for forest visitors and greater visual penetration since there is often less vegetation under maple overstories.

4. Alternative 4

This alternative will primarily use the shelterwood harvest method with reserves. This alternative would give the most flexibility to manage the desired visual variety and visual-quality objectives depending on the visual outcome and stand condition after the initial timber cuts are made. Final removal can be postponed, varied in remaining basal area, or delayed indefinitely.

L. MINERAL RESOURCES

Within the Forest proclamation boundary is the geologic potential for a variety of minerals ranging from energy-related minerals to industrial-use minerals and rare-earth elements. Energy-related minerals include oil, gas and coal, while Tripoli, limestone and fluorite are considered industrial minerals. There has been no production of oil, gas or coal on Forest lands. The demand for minerals fluctuates and is difficult to predict. Many factors such as price, economic feasibility of extraction, technological advances and supply can determine the demand.

There are many legislative regulations determining the administration of federal minerals. For oil and gas and some industrial minerals such as tripoli, the Bureau of Land Management (BLM) is responsible for the issuance of federal leases, while the Forest is responsible for the surface management as the Surface Management Agency. Other common-variety minerals, such as limestone, are managed by the Forest.

Approximately 30 percent of the mineral estate is privately owned, either by reservation or outstanding rights. The mineral estate is generally the dominant estate.

ALL EFFECTS ON MINERAL RESOURCES

None of the management or use activities proposed under any of the alternatives is anticipated to have any effect on the mineral resources of the Forest.

M. SOCIOECONOMICS

1. SOCIAL IMPACTS

During the planning process, numerous public meetings were held to offer stakeholders an opportunity to express their wants, needs and demands for access to and use of national forest resources. These public meetings, however, can represent only a portion of the public's interest and not necessarily that of those who do not or cannot attend these meetings. In preparation for revising the Plan, the Forest commissioned Indiana University to conduct a social assessment of the region in and near the SNF (Welch and Evans, 2003). This social assessment is a continuation of previous work conducted by the Forest Service during the development of the 1998-1999 Monitoring and Evaluation Report, which identified key issues faced by the Forest. By addressing and documenting stakeholder perceptions and the communities' relationship with the forest, the social assessment seeks to contribute to the understanding of issues important to the management of forest resources.

The social assessment provided information on Forest resource uses and values. Participants viewed the Forest in profoundly different ways. Recreation and use of the forest resources were very important to many. Some had favorable views of many activities on the Forest, while others had mixed views of differing activities. Yet others saw the Forest from a spiritual point of view. The management of recreation and the ecology of the Forest are two of the major concerns assessment participants had about the Forest.

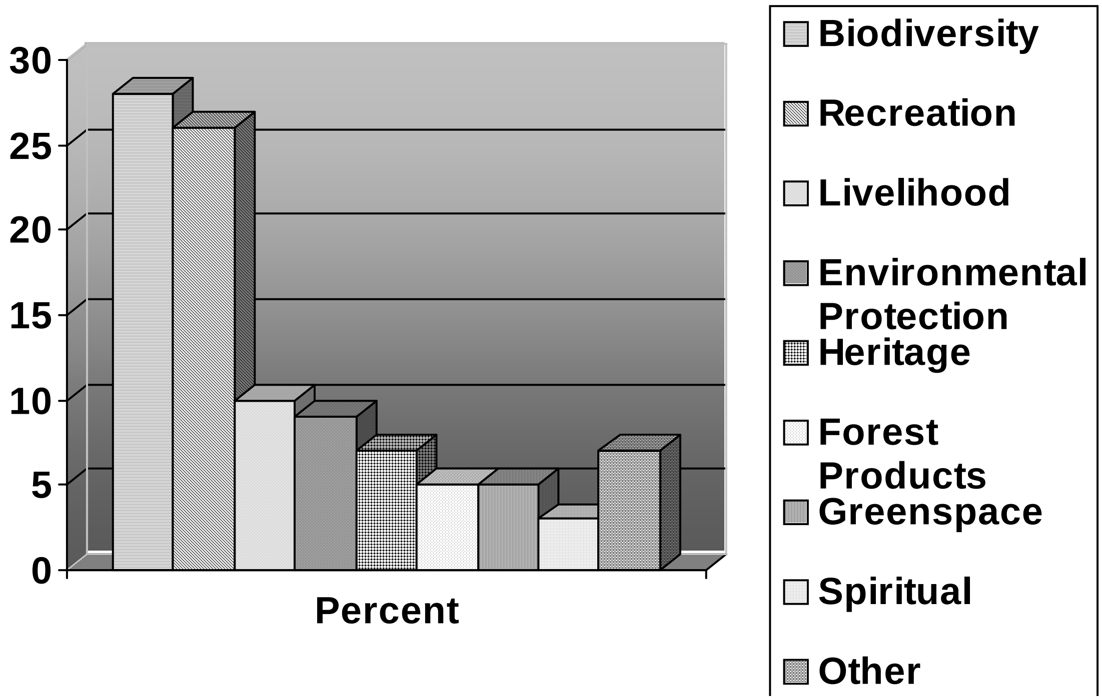


Figure 3-4. Survey participants' views of Forest values.

In one component of the social survey, participants were asked to answer questions about the importance of particular values associated with the Forest, including biodiversity, livelihood, environmental protection, forest products, spirituality, green space, recreation, heritage and culture. They were asked which aspect they valued the highest. The proportional value of Forest values is not meant to be statistically representative of residents of southern Illinois or of stakeholder groups in general; these findings demonstrate the diversity of views held by representatives of stakeholder groups.

The management of recreation and the ecology (biodiversity) of the Forest are the two largest concerns participants had about the Forest. Twenty-eight percent of the participants favored biodiversity, whereas a nearly equal amount (26 percent) valued recreational opportunities over the rest. Smaller numbers of participants favored livelihood (10 percent), environmental protection (9 percent) and heritage (7 percent) values. The values favored least by the survey participants included forest products (5 percent), green space (5 percent) and spiritual values (3 percent), respectively.

The majority of participants favored management objectives that would encourage and protect the biodiversity (28 percent) and environment of the forest (9 percent). The next most-favored forest value is recreation (26 percent).

2. ECONOMIC IMPACTS

Economic effects on local counties were estimated using an economic input-output model, IMPLAN. (The economic impact analysis is further described in Appendix B.) The Forest provides direct and indirect, multiple, economic benefits to Illinois and surrounding states, and especially to individuals and communities within close proximity to the Forest. Employment and labor income figures were derived from recreational users' expenditures in the regional economy, purchases of timber from area firms, federal payments to the state and counties, and agency expenditures in support of Forest Service programs. Economic impacts of each alternative are given in the tables below.

Table 3.56 illustrates how the various alternatives differ from the current management situation in terms of jobs. Due to substitution-effects from competing non-government sources, these jobs are characterized as being *associated* with local economic activity initiated by Forest Service programs and activities, rather than *caused* by these activities. Each of the alternatives provides a range of human influence and a range of forest resource uses.

Table 3-56. Employment by program by alternative: Total number of jobs contributed.

Expenditure Source	Current	Alternative 1	Alternative 2	Alternative 3	Alternative 4
Recreation	257	289	274	269	296
Grazing	0	0	0	0	0
Timber	0	34	59	0	57
Minerals	0	0	0	0	0
Payment to States/Counties	4	4	4	4	4
Forest Service Expenditures	152	164	174	155	177
Total Forest Management	412	491	510	428	534
Percent Change from Current (Alternative 1)	--------	19.1%	23.8%	3.8%	29.5%

Labor income by alternative is presented in Table 3.57. Current labor income from forest management is $10.4 million per year. Overall, Forest Service expenditures provide the highest level of labor income, followed by recreation expenditures. Alternatives 2 and 4 provide the highest labor income, $13.2 and $13.7 million per year, respectively. Alternative 1 supplies a slightly lower level, $12.7 million and Alternative 3 is similar to the current level. Again, timber production leads to the largest incremental increases in labor income for Alternatives 1, 2 and 4.

Table 3-57. Labor income by program by alternative (in millions of dollars).

Revenue Source	Current	Alternative 1	Alternative 2	Alternative 3	Alternative 4
Recreation	4.9	5.5	5.2	5.1	5.6
Grazing	0	0	0	0	0
Timber	0.0	1.0	1.8	0.0	1.7
Minerals	0	0	0	0	0
Payment to States/Counties	0.1	0.1	0.1	0.1	0.1
Forest Service Expenditures	5.3	6.1	6.0	5.4	6.2
Total Forest Management	10.4	12.7	13.2	10.6	13.7
Percent Change from Current (Alternative 1)	--------	23.0 %	27.1%	2.6%	32.0%

The percent-changes in income from the current situation are increases under any of the alternatives: 2.6 percent under Alternative 3, 23.0 percent under Alternative 1, 27.1 percent under Alternative 2 and 32.9 percent under Alternative 4. Recreation contributes the most income to the total under any of the alternatives. Timber contributes the next most under Alternatives 1, 2 and 4. Payments to states and counties provide a minor amount of income under any of the alternatives and grazing and minerals provide no jobs.

Table 3-58. Employment by major industry by alternative (average annual, first decade: Total number of jobs contributed).

Industry	Current	Alt. 1	Alt. 2	Alt. 3	Alt. 4
Agriculture	4	4	5	4	5
Mining	0	0	0	0	0
Construction	8	9	10	10	10
Manufacturing	4	24	38	5	37
Transportation, Communication, & Utilities	9	11	12	9	13
Wholesale Trade	11	14	14	11	15
Retail Trade	147	170	163	154	175
Finance, Insurance, Real Estate	9	11	11	9	12
Services	127	149	148	132	156
Government (Federal, State and Local)	92	97	107	93	109
Miscellaneous	2	2	2	2	2
Total Forest Management	412	491	510	428	534
Percent Change from Current (Alternative 1)	______	19.1%	23.8%	3.8%	29.5%

Employment and income found in Tables 3.57 and 3.58, respectively, are divided into the major sectors of the local economy identified in Tables 3.59 and 3.60. Although there is some variance in the order, manufacturing, services, retail trade and government are the four sectors most affected by Forest Service programs and expenditures under all alternatives. Although relatively little manufacturing employment and labor income is contributed to the area's economy as a result of Forest Service management, under each of the four alternatives, manufacturing is the sector most affected by Forest Service programs and expenditures. Agriculture, construction and wholesale trade are the sectors least affected under all alternatives and minerals and miscellaneous programs are not affected by Forest Service programs and expenditures.

The government sector provides the highest level of labor under all alternatives. It is followed by the services and retail trade sectors. Across all alternatives, these three sectors account for approximately 80 percent of the labor income.

The magnitude of payments to counties expected in the first decade is the same under each of the alternatives. Actual payments to the counties are based on recent legislation contained in the Secure Rural Schools and Community Self-Determination Act of 2000 (PL106-393). All the counties in this impact area selected the full-payment option that allows each county to receive its share of the average of the three highest 25-percent payments during the period 1986-1999. There is no difference among the alternatives.

Table 3-59. Labor income by major industry by alternative (average annual, first decade in millions of dollars).

Industry	Current	Alt 1	Alt 2	Alt 3	Alt 4
Agriculture	0.1	0.1	0.1	0.1	0.1
Mining	0.0	0.0	0.0	0.0	0.0
Construction	0.3	0.4	0.4	0.4	0.4
Manufacturing	0.2	0.8	1.3	0.2	1.2
Transportation, Communication, and Utilities	0.4	0.5	0.5	0.4	0.5
Wholesale Trade	0.4	0.5	0.6	0.4	0.6
Retail Trade	2.2	2.5	2.5	2.3	2.6
Finance, Insurance, Real Estate	0.2	0.3	0.3	0.2	0.3
Services	2.8	3.3	3.3	2.9	3.5
Government (Federal, State and Local)	3.8	4.3	4.3	3.7	4.4
Miscellaneous	0.0	0.0	0.0	0.0	0.0
Total Forest Management	10.4	12.7	13.2	10.6	13.7
Percent Change from Current (Alt. 1)	______	30.7%	23.3%	2.6%	28.0%

Recreation, Forest Service expenditures and timber are the Forest's main contributors to the local economy in terms of employment and labor income, except under Alternative 3, which has no timber program to generate employment or income. Payments to states and counties remain unchanged under each of the alternatives, and mining and grazing programs contribute nothing to the local economy.

Table 3-60. Current role of Forest Service-related contributions to the area economy.

Industry	Employment (jobs)		Labor Income ($ million)	
	Area Totals	FS-Related	Area Totals	FS-Related
Agriculture	11,745	4	139.0	0.1
Mining	2,112	0	128.7	0.0
Construction	16,540	8	556.6	0.3
Manufacturing	21,731	4	910.1	0.2
Transport, Communication, Utilities	12,121	9	506.9	0.4
Wholesale Trade	8,874	11	312.9	0.4
Retail Trade	43,318	147	674.9	2.2
Finance Insurance and Real Estate	12,000	9	309.1	0.2
Services	63,997	127	1,749.1	2.8
Government	40,211	92	1,401.7	3.8
Miscellaneous	1,594	2	13.2	0.0
Total Forest Management	234,243	412	6,702.3	10.4
Percent of Total	100.0%	0.2%	100.0%	0.2%

The spatial boundary for the consideration of cumulative economic impacts includes the counties that make up the economic impact area: Alexander, Gallatin, Hardin, Jackson, Johnson, Massac, Pope, Pulaski, Saline, Union and Williamson, in Illinois; Ballard, McCracken and Crittenden, in Kentucky; and Cape Girardeau and Perry, in Missouri. Table 3.61 illustrates the percentage contribution to the area's economy of the Forest's present management program. The Forest currently plays a minor role in the economy of the analysis area. It is associated with only 0.2 percent of the local economy's total jobs and 0.2 percent of the labor income. However, each of the alternatives proposes an expanded role in terms of overall economic activity, especially Alternatives 1, 2 and 4. Government, services and retail trade are the sectors of the economy that show the most benefit from the Forest's activities.

Analysis of the cumulative effects reveals the context of the impacts of the alternatives within the planning area and over time. This is done by comparing total changes in the planning area under each alternative to total changes under no action. Such a comparison is done by estimating employment and income at the expected end of the forest planning horizon, about15 years, and calculating the share of the total economy that each alternative represents of the entire economy. Estimates for employment and income growth were derived by calculating the average annual increase in employment and the real average annual income growth for counties in the analysis area from 1969 to 2000 using US Bureau of Economic Analysis county-level data.

The analysis assumes that the underlying economic relationships hold constant at the 2000 levels. Forest Service data related to Forest Service programs are for the 15-year planning horizon. Also, the assumption is made in our analysis that the same rate of growth experienced during the 1969 to 2000 time-period will continue over the 15-year Plan.

Table 3.61 displays cumulative effects using employment and labor income for the planning area. The first two columns present the 2000 base-year data for the planning area and the portion of the base-year attributable to use and management of the national forest. The next column shows projections made for 2015. Included in the projections are employment and income effects attributable to the current direction (Alternative 1, or No Action). The remaining columns of the table show cumulative effects for each alternative over the planning horizon, which ends in 2015. Forest program outputs for each alternative are for the 15-year planning horizon.

Table 3-61. Cumulative economic impacts in 2015.

Economic Indicator	2000		2015			
	Area Totals	Forest Portion	Forest Portion			
			Alt. 1	Alt. 2	ALT. 3	Alt. 4
Employment						
Total Jobs	234,243	412	491	510	428	534
% Change from Current	-	-	19.1	23.8	3.8	29.5
Labor Income						
Total ($ million)	6,702.3	10.4	12.7	13.2	10.6	13.7
% Change from Current	-	-	23.0	27.1	2.6	32.0

For the proposed alternatives, expected changes in the total number of jobs from current conditions will range from 3.8 percent under Alternative 3 to 29.5 percent under Alternative 4. The selected alternative, Alternative 2, shows a 23.8 percent change over current conditions in 2015. Expected changes to labor income from current conditions will range from 2.6 percent under Alternative 3 to 32.0 for Alternative 4. Alternative 2 shows a 27.1 percent change and Alternative 1 a 23.0 percent change. The cumulative effects analysis shows that, over time, the employment and income share of the economy attributable to national forest program management will increase under each of the alternatives, but most markedly under Alternatives 1, 2 and 4.

3. PRESENT NET VALUE (PNV) OF THE ALTERNATIVES

Table 3-62 displays the estimated PNV, net costs and cumulative PNV by alternative. All figures are in fiscal year 2000 dollars. The PNV in Table 3-63 includes market values and non-market estimated values. Market values include those where the Forest Service receives money, such as for timber, special uses, etc. Non-market values are estimated values of amenities, such as recreation, including hunting and fishing and non-consumptive wildlife, which under any alternative provides the greatest amount of benefits. As can be seen below, the relative ranking of all four alternatives does not change from the first decade (0-10 years) to the last decade (90-100 years).

Alternative 3 has the highest PNV because of its relatively high values for recreation. However, the overall PNV costs are the lowest of all alternatives primarily due to a substantially lowered cost for both recreation and timber/vegetation management. Alternative 3 emphasizes management for mature and old-growth forest across the landscape, non-motorized recreation, additional restrictions on equestrian use and additional habitat for forest-interior wildlife and plants.

Alternative 1, the current management direction, has the second-highest PNV because it has relatively low costs for both vegetation management and recreation, while garnering a high value for recreation. Although it has the highest recreation values, Alternative 4 has the lowest PNV because it has the highest recreation costs of any of the alternatives. It also has the highest timber/vegetation management costs.

Alternative 2, with its emphasis on a variety of recreational opportunities and forest ecosystem health and sustainability, has relatively high recreation and vegetation management costs, but also high recreation values. It has the third-highest PNV, the second-highest recreation costs, the second-lowest timber and vegetation management costs and, finally, the second-highest recreation cost.

In assessing these non-market, aesthetic-resource values, values and costs proposed for management of these benefits (recreation and wildlife and vegetation management) varies by alternative. Alternative 2 provides the most overall benefits (maintained recreation values and moderate vegetation management costs); Alternative 4 is similar, but includes higher vegetation management costs; Alternatives 1 and 3 are similar, with high recreation values and very low vegetation-management.

By maintaining a forest ecosystem, the SNF also provides the public with many valuable, non-market/non-monetary resource benefits that are not fully considered in the PNV analysis. These benefits are not available, or are of limited availability, on other lands, particularly private lands. These include a forested landscape with high visual quality, clean water resources and habitat for a wide range of forest plant and animal species. These values also are most beneficial to recreation and wildlife, the resources that provide the most benefit to the Forest Service.

Table 3-62. PNV by alternative (in thousands of dollars).

Program	1	2	3	4	5	6	7	8	9	10
Alternative 1										
Recreation Values	$55,961	$105,195	$143,885	$174,669	$199,578	$220,058	$237,256	$251,967	$264,764	$276,062
Recreation Costs	-26,155	-37,279	-44,579	-49,510	-52,842	-55,093	-56,613	-57,640	-58,334	-58,803
Timber/Vegetation Mgmt Cost	-5,559	-9,906	-13,112	-15,362	-15,841	-15,929	-15,994	-16,037	-16,049	-15,957
Cumulative Total PNV	**$24,247**	**$58,010**	**$ 86,194**	**$109,827**	**$130,895**	**$149,036**	**$164,649**	**$178,290**	**$190,381**	**$201,302**
Alternative 2										
Recreation Values	$57,716	$108,363	$148,095	$179,672	$205,095	$225,957	$243,421	$258,314	$271,233	$282,610
Recreation Cost	-49,165	-76,428	-94,804	-107,217	-115,603	-121,269	-125,096	-127,682	-129,429	-130,609
Timber/Vegetation MgmtCost	-7,021	-8,902	-10,193	-12,159	-11,420	-11,251	-11,078	-10,741	-10,421	-10,159
Cumulative Total PNV	**$1,530**	**$23,033**	**$43,098**	**$60,296**	**$78,072**	**$93,437**	**$107,247**	**$119,891**	**$131,383**	**$141,842**
Alternative 3										
Recreation Values	$57,716	$108,363	$147,816	$178,869	$203,748	$224,135	$241,217	$255,817	$268,516	$279,731
Recreation Cost	-21,501	-31,475	-37,998	-42,404	-45,381	-47,392	-48,750	- 49,668	-50,288	-50,707
Timber/Vegetation Mgmt Cost	-2,466	-3,376	-3,692	-3,904	-4,048	-4,145	-4,211	-4,255	-4,285	-4,306
Cumulative Total PNV	**$33,749**	**$73,512**	**$106,126**	**$132,561**	**$154,319**	**$172,598**	**$188,256**	**$201,894**	**$213,943**	**$224,718**
Alternative 4										
Recreation Values	$59,441	$111,670	$152,656	$185,231	$211,447	$232,939	$250,902	$266,193	$279,428	$291,058
Recreation Cost	-53,656	-81,742	-100,673	-113,461	-122,101	-127,938	-131,881	-134,544	-136,344	-137,560
Timber/Vegetation Mgmt Cost	-8,237	-12,364	-15,202	-18,442	-18,737	-19,041	-19,368	- 19,336	-19,245	-19,096
Cumulative Total PNV	**-$2,452**	**$17,564**	**$36,781**	**$53,328**	**$70,609**	**$85,960**	**$99,653**	**$112,313**	**$123,839**	**$134,402**

CHAPTER 4. CONSULTATION AND COORDINATION

I. PREPARERS

A team of Forest Service associates representing a broad spectrum of disciplines was responsible for writing and compiling the planning documents. The team was guided by the ideas, philosophy and experience of its members, as well as by the contributions of other federal and state agencies, scientists and land managers, and the public.

Table 4-1. SNF Interdisciplinary Planning Team.

Participant	*Area of Expertise*	*Education*	*Years of Experience*
Richard Blume-Weaver, Planning Team Leader	Land Resource Planning and Management	MLA, Landscape Architecture; BA, English	35
Stephen Hupe, Interdisciplinary Team Leader	Land Management Planning; Silviculture	MS, Forest Management BS, Forest Management	27
Rebecca Banker	Public Involvement	BS, Wildlife Management	20
Bryan Fitch (transferred)	Soils; Watershed Management	MS, Soil Science BS, Plant and Soil Science	20
John Varro (retired)	Land Ownership	BS, Forestry	30
John Taylor	Land Ownership; Special Uses; Minerals	BS, Forestry	32
Stephen Widowski	Wildlife Biology; Ecology	MS, Zoology. BS, Biology	28
Patricia York	Recreation	MS, Outdoor Recreation BS, Forest Management	23

Table 4-2. Significant SNF Contributors.

Marion Bunch	Recordkeeping, Editing
Michael J. Clevenger	Compartment Records Updating
Nicholas Giannettino	Fire Management
David Huggins	Compartment Records Updating
David Johnson (retired)	Visual Resource Management
Richard Johnson (retired)	Silviculture, Timber Management
Anthony Kirby	Transportation Planning
Kara Kleinschmidt	Soils, Watershed Management
Mary McCorvie	Heritage Resources, Social-Economics
Monica Neal	Recordkeeping, Editing
Tom Neal	Compartment Records Updating, Timber Management
Timothy Pohlman	Trails Planning, Recreation Management
Donna Rann	Typing
Lisa Roper	Webmaster
Elizabeth Shimp	Botany, Ecology
Michael Spanel (retired)	Wildlife Management
Tiesha Street	Database Management
Kris Twardowski	Database Management, GIS Mapping
Jeremy Vaughn	GIS Mapping
Melinda Walker	Transportation Database Management
Michael Welker	Fisheries Management, Aquatic Biology
Bob Winters (retired)	Compartment Records Updating

Table 4-3. Forest Leadership Team.

Hurston Allen Nicholas	Forest Supervisor
Rebecca Banker	Public Affairs Officer
Richard Blume-Weaver	Planning Staff Officer
Nicholas Giannettino	Resources Staff Officer
Dan Lentz	Mississippi Bluffs District Ranger
Monica Neal	Forest Supervisor's Administrative Assistant
Eva Pontious	Union President
Jeff Seefeldt	Hidden Springs District Ranger
Keri Shimp	Budget and Finance Officer
Cathy Slover	Support Staff Officer

Table 4-4. Forest Service and Regional Office Contributors.

Mike Ablutz	Silviculture
Gene DeGayner	Wildlife Biology
Sam Emmons	Forest Planning
Ted Geier	Watershed Resources
Rick Hokans	Economics, Computer Modeling
Mark Hummel	Public Involvement
Jim McDonald	NEPA
Claudia Mielke	Recreation Management
Ron Mulach	NEPA and Legal Counsel
John Romanowski	Wilderness Management, Wild and Scenic Rivers
Charles Sams	Air Quality
Don Vandendriesche	Forest Vegetation Simulator, Yield Tables

Table 4-5. Other Significant Contributors.

Dave Cooper	IDNR Liaison (retired)
Jody Shimp	IDNR Liaison
Kendrick Greer	Spectrum Contractor
Steven Daniels, Ph.D.	Collaborative Public Involvement
Gregg Walker, Ph.D.	Collaborative Public Involvement
The thousands of interested people who participated in the plan revision process.	

II. RECIPIENTS OF FEIS

Copies of the FEIS, the 2006 Land and Resource Management Plan and/or Summary were sent to the following federal, state and local agencies, tribal governments, organizations, libraries, businesses and individuals. Copies of these documents are available at all Forest offices and on the Forest website.

Elected Federal Officials

The Honorable Richard Durbin
The Honorable Barak Obama
The Honorable John Shimkus
The Honorable Jerry Costello

Elected State Officials

Governor Rod Blagojevich
Senator Gary Forby
Senator David Luechtefeld
Representative Brandon Phelps
Representative John Bradley
Representative Mike Bost

Tribal Offices

Eastern Shawnee Tribe
Keetoowah Band
Peoria Tribe of Indians of Oklahoma

Federal Agencies

Advisory Council on Historic Preservation
Bureau of Land Management
EPA Region 5
Federal Highway Admin., Springfield, IL
Great Lakes Federal Aviation Administration
Green Mountain – Finger Lakes NF
Huron – Manistee National Forest
Mark Twain National Forest
Monongahela National Forest
National Landmarks
National Park Service
North Central Forest Experimental Station
NRCS – National Environmental Coord.
NRCS – Tamms Service Center
Ohio River Basins Commission
Ottawa National Forest
US Army Engineer, Mississippi Valley Division
US Fish and Wildlife – Crab Orchard Wildlife Refuge
US Fish and Wildlife – Cypress Creek Wildlife Refuge
USCG – El Branch
USDA – National Library
USDA – Office of General Council
USDA – Region 9 – Regional Office
USDA – APHIS PPD/EAD
USDE – Director, NEPA Policy
USEPA – Office of Federal Activities

Illinois State Agencies

IDNR – Department of Forestry
IDNR – Department of Fisheries
IDNR – National Heritage
Illinois EPA
Illinois Abandoned Mine Lands
Illinois Association of Park Districts
Illinois Association of RC & D Areas
Illinois Department of Corrections
Illinois Department of Public Health
Illinois Department of Transportation
Illinois Environmental Education Advance
Illinois Geological Survey
Illinois National Guard
Illinois Native Plant
Illinois Natural Gas/Oil
Illinois Natural Preserve Commission
Illinois Park and Recreation
Illinois State Museum
Illinois State Water Survey
Illinois Tree Farm System
Kincaid-Reed's Creek Conservation District
Land & Water Resource – State Fairgrounds
Natural Resource Advisory Board
Office of the Governor
Rend Lake Conservation District

County Governments

Alexander County Board
Alexander County Commissioners
Alexander County Sheriff
Champaign County PF
Clinton County Farm Bureau
Dewitt County Farm Bureau
Franklin County Preservation Area
Gallatin County Commissioners
Gallatin County Tourism
Hardin County Commissioners
Hardin County Highway Department
Hardin County Sheriff
Hardin County Water District
Henry County Farm Bureau
Jackson County Commissioners
Jackson County Soil and Water
Johnson County Commissioners
Johnson County Highway Department
Kankakee County PF
Knox County Courthouse
Macoupin County FB
Massac County Commissioners
Mercer County Farm Bureau
Ogle County Soil and Water
Pope County Commissioners
Pope County Highway Department
Pope County Sheriff
Pope County Commissioners
Pope/Hardin County Soil and Water
Pulaski County Commissioners
Pulaski County Sheriff
Saline County Commissioners
Saline County Historical Society
Union County Commissioners
Union County Highway Department
Union County Highway Superintendent
Union County Refuge
Union County Sheriff
Williamson County Farm Bureau
Williamson County Sheriff

Local Agencies

Ava Fire Department
Brookfield Zoo
Burnside Township – Water
Carbondale Fire Department
Carrier Mills Fire Department
City of Alto Pass – Water
City of Anna – Mayor
City of Anna-Jonesboro – Water
City of Cairo – Mayor
City of Elizabethtown – Mayor
City of Golconda – Mayor
City of Harrisburg – Mayor
City of Harrisburg – Soil and Water
City of Harrisburg Police
City of Jonesboro – Mayor
City of Jonesboro – Mayor
City of Marion - Mayor
City of Murphysboro – Mayor
City of Murphysboro – Soil and Water
City of Vienna – Mayor
City of Vienna – Soil and Water
City of Vienna Police
Cobden Fire Department
Creal Springs Fire Department
Decatur Park District
Desoto Fire Department
Desoto Fire Department
DeSoto Township
DuQuoin Fire Department
Elkville Fire Department
Fort Massac Water District
Galatia Fire Department
Glenview Park District
Goreville Fire Department
Gorham Fire Department
Grand Tower Township
Havana Park District
Herrin Fire Department
Horseshoe Lake Fire Department
Hurst Fire Departmetn
Imperial Valley Water District
Kincaid Road Commissioner
Kincaid Township
Kincaid-Reed's Creek Conservation District
Lake of Egypt Fire Department
Mackinaw Valley Township Water
Makanda Fire Department
Makanda Township Superintendent
Millstone Township Water
Omaha Fire Department
Ora Township
Ridgeway Fire Department
Ridgeway Township – Soil and Water
Sandridge Township Highway
Sesser Fire Department
Tamaroa Fire Department
Urbana Park District
Urbana Park District
Vienna Fire Department
Vienna High School
Village of Gorham
West Frankfort Fire Department
Wheaton Park District

Libraries

Benton
Bloomington
Booth
Cairo
Cape Girardeau
Carbondale
Carrier Mills
Carterville
CE Brahm Memorial
Creal Springs
Decatur
DeKalb
Dongola
DuQuoin
Eldorado
Evansville
Golconda
Harold Washington
Harrisburg
Herrin
Illinois State University
John A. Logan College
Limestone Township
Marion
Metropolis
Northern Illinois Univ.
Paducah
Peoria
Quincy
Rend Lake College
Rockford
Rosiclare
Sally Logan
Shawnee
SE Illinois College
Springfield
Stinson
University of Illinois
Vienna
Western University

Media

Anna Gazette
Daily Register
Gazette Democrat
Metropolis Planet
Zimmer Radio

Schools and Colleges

John A. Logan President
Northern Illinois University President
Parkland Community College President
Shawnee Community College President
Southeastern Illinois University President
Southern Illinois University Forestry
University of Illinois Natural Resources
University of Pittsburgh President
Western Illinois University President

Organizations and Businesses

Ameren CIPS
Blue Ribbon
Brookfield Zoo
Hayes Canyon
IL Tree Farm
Lone Star
Lusk Creek
Mackinaw
Maplelawn
Marlin Hunting
Mercer Co
Millstone
Olney Central
S.M.I.T.B.
So IL Center
Trail of Tears
Unimin Corp
Wind Harp Farms

Individuals

Adams, H
Alban, Lynn
Allard, Edward
Alstat, Fred
Alstat, William
Anderson, Charlotte
Anderson, Wayne
Atkins, Cameron
Austin, Dan
Baker, Ellen
Baker, Helen
Baltz, Michael
Bame, Dean
Bannon, Amy Lou
Barger, Loren/Aletta
Barlett, Timothy
Bateman, Reid
Bates, Larry
Beattie, James
Beck, Judy
Beckham, JoAnn
Bell, Morris
Benaroya, Martha
Benefield, Cindy
Biddle,Dennis
Bixler, J
Black, Jr
Blackman, Charles
Blake, Ronald
Blakely, Valeria
Blasdel, Tom
Blue, Gene
Bodine, Jane
Boehm, Ronald
Bowman, Bill/Dorothy
Bowman, Frank/Stacy
Boyd, Bill
Boyd, Bill R.
Bozarth, J
Bradley, Craig
Bradley, Sally/Charles
Brauer, John/Sharon
Bray, Richard
Brenner, Tim
Brewer, John
Brinker, Ruth
Brookman, Treasa
Brown, Marian
Bruhy, Mark
Brunner, Kenneth
Brunner, Larry
Buckardt, Nan
Bundren, Mike
Burns, Bill
Butler, Dr. Brian
Caffee, Fran
Camp, Bob
Campion, Robert
Casebeer, Jonathan
Catt, Bob
Cawley, Chuck
Charles, Debra/Ronald
Chen, Tony
Childers, Donald
Chumbly, Debbie/Trevor
Clark, Beale
Clarke, Tom
Clevenger, Bill
Clutts, Gerald/Jerry
Colant, Patricia
Coon, Dr. & Mrs. John S
Cornett, Douglas R
Cota, Family
Covi, Michelle
Coyle, James
Crippen, Butch
Cripps, Fred
Crosier, Yvonne
Curtis, Michael
Cushman, John/Carolyn
Dahm, Norm
Dalessandro, Domenico
Dalsin, Jerry
Damon, Helen
Darnell, Nancy
Daum, Bob
Davidson, RC
Davinroy, Dan
Davis, John
Davis, Kevin
Derk, James
Dessecker, Dan
Dickson, John
Dolan, Patrick M
Donham, Mark
Dosier, Dan
Dowen, Matt
Easley, Paul
Edwards, William
Elliott, Russell
Ellison, Mary Ann
Esary, Mark
Estel, Mike
Faulkner-Dempsey, Judy
Faust, Daniel
Feakes, Nancy
Fennerty, Janet
Fertaly, Margaret
Fisher, Kenneth
Fishman, Constance A
Fletcher, S & R Iltis
Flood, Dan
Frailey, Karen
Frailish, Jim
Frankland, Les
Fredrickson, Leigh
Freitag, Louis
Frick, Carl Joe
Friedt, Vonda/Joseph
Gaines, David
Gale, Warren
Gallagher, Michael
Garness, Nancy L
Gauch, William
Gendry, David T
George, Ray

Gephart, Don
Gill, Kara
Gillio, Viva
Glass, Gunter
Glassford, James
Glosser, Deanna
Godson, Lawrence
Golden, Frank
Graff, Carl H
Graham, Sandra/Walter
Granneman, Linda
Grant, Davis
Grubbe, Les Michael
Guetersloh, Mark
Guinn, Edward
Guthrie, Charles
Haaker, Anne
Haas, Crystal A
Hall, A.
Halter, Bill/Judith
Hamm, Alex
Hankins, Chuck
Hanson, D.
Hanson, Kristi
Harding, Bill
Harney, Edward/Sue
Harris, George/Mary
Hawk, Burleigh
Helmer, Irvin
Heltne, Paul
Hente, David
Heup, Phil
Hirst, Shawn
Hish, John
Hoene, Mary/Gerald E
Hogan, Bob
Hogg, Steven/Debra
Holvay, Ralph
Hoock, Lee
Hopkins, Billie
Hunter, Bob
Ice, Ann
Isenberg, Jon
Ital, Keith/Jackie
Jacober, Steve
Jagosh, Michael
Jones, Cory
Jones, Mary Jean
Jones, Rick
Jones, Tony
Kandare, Richard
Kaylor, Marty
Keller, Thomas
Kennedy, Linda
Kern, Ron
Kirkland, Jim
Kirkpatrick, John
Kishpaugh, Geoff
Kissiar, David
Kleinman, Sidney C
Klueter, Karla
Knake, E. William
Koester, Charlie
Komorous, Robert M
Korando, Herbert
Korte, Kent
Korte, Mike
Krausz, Ray
Kruse, Glen
Kutska, Ken
Lach, Joseph
Lacy, David
Lashbrook, Thomas
Laubscher, Ben/Patti
Lee, Christine
Lence, Linda
Lewis, James
Limp, Robin
Looser, Jim
Loots, Melanie
Luthy, Peggy
Lutkey, Jerry L
Malone, Thelma
Martinez, R.
Massey, Carol
Matalonis, Paul
Matherly, Brenda
Matteoni, Vasco
Max, Edward R
Maxfield, John
McCarthy, Mary
McFarland, Larry/Venita/Leanette
McFarlene, Jim
McKasson, Barbara
McMillean, Bruce
Mehrer, Mark
Merkel, Albert
Methven, Andrew
Meyer, Fred
Mick, Thomas
Miller, Dick
Miller, Kenneth
Miller, Susan
Mockford, E.L.
Mohns, L.A.
Mohr, Jeremy
Monk, David
Montorfano, Celina
Moon, Bob
Morissettemol, Patricia
Morrical, Ernest
Morse, David
Moss, Michele
Moyer, Carl
Mueller, Jeff
Mulach, Ron
Muller, Jon
Murphy, Julie
Murphy, Mike
Nelson, David
Newcomb, Joe
Nichols, Richard
Nicolay, Kimm
Obermark, Jesse
Obermark, Paul/Cindy
Obernborfer, Jim
O'Daniel, J.D.
O'Dell, John/Maralee
O'Donnell, Carol
Ohse, Kimberly
Ordonez, Richard
O'Rourke, James R
Owens, Kenneth
Parkinson, David
Pate, Hazel
Pawelko, K.A.
Pech, Diane
Peharel, Douglas
Pereira, Peter
Peter, Gary
Petrocelli, Johnny
Phelps, Former Congressman
Phelps, John
Piechowski, James
Pierson, John
Pleines, Melvin
Pottorff, Doug
Potts, Gary
Pray, Dwight L
Princen, Bert
Ranz, Ann
Raynalds, Donna
Reed, Terry
Reindol, Robert
Rendleman, LeeRoy
Reynolds, Jonah
Rhine, Dr. G.K.
Richards, Ken
Richardson, Phil/Sheila
Rodely, Pamela L
Ross, Family
Rothman, Alvin
Rowell, Samuel
Ruffner, Charles
Russell, Sherman
Sampson, Patricia/Donald
Schultz, Huberta J
Seavers, Wayne/Karen
Sellers, Paul
Shipley, Howard
Short, Duane
Shroyer, Darwin
Sipp, Stan
Skidmor, Bobby
Sliwa, Jean
Smith, Dorland
Smith, Lloyd
Smith, Margaret
Smith, Sam
Smith, Sandra
Steele, Lenville
Stone, Harold/Lynda
Stone, Steven
Struck, Pat A
Stuart, Michael
Suchy, David
Tait, Barbara
Ternaprovich, Dale

Thiel, Dennis/Jeann
Thomas, Dan
Thomas, Mitzi
Thornberg, Dennis
Thurston, Lisa
Tippy, Kay
Tippy, Robert
Toberman, Mark
Tredway, H. W.
Trover, Marleis
Turner, Fred
Vaupel, Kelley/Tonya
Verink, Dr. Randy
Victorn, Marshall
Wagner, Josh
Wagner, Robert
Walker, James
Warrington, Richard
Webb, Kevin
Welch, Gail/Noble
Wells, Roger
Wendt, Robert L
Wenzel, Jerry
Werner, Patricia
West, Andy
Westlake, Kenneth A.
Wheeler, Loretta/Terry
Whitlock, Stephen
Whitton, Richard
Wilkerson, Cherrie
Williams, Danny
Williamson, Tom
Youther, Michael
Zimmer, Gary

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Citizen's Call for Ecological Forest Restoration

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INDEX

A

B

L

M

N

O

P

R

S

T

U

V

W