Final Environmental Impact Statement for the Land and Resource Management Plan

United States
Department of
Agriculture

Forest Service

Southern Region

Land Between The Lakes National Recreation Area

Management Bulletin R8-MB-119B Vol. 1 December 2004

Final Environmental Impact Statement
for the
Land and Resource Management Plan

Land Between The Lakes
National Recreation Area

Trigg and Lyon Counties in Kentucky
Stewart County, Tennessee

United States Department of Agriculture
Forest Service
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ABSTRACT

This Final Environmental Impact Statement (FEIS), prepared by the United States Department of Agriculture Forest Service, is required in conjunction with the revision of the Tennessee Valley Authority's (TVA) 1994 Natural Resource Management Plan (NRMP). It discloses and explains the direct, indirect, and cumulative environmental impacts of the four alternatives developed during the revision of the 1994 Plan into a Forest Service Land and Resource Management Plan (LRMP), or Area Plan, for Land Between The Lakes (LBL). The four alternatives call for varying degrees of change, and are titled alternative W, X, Y, and Z. A "no action" alternative is included (Alternative W), which would continue the management in a manner consistent with TVA's 1994 Plan. The alternatives provide different mixes of goods and services through various goals, objectives, land allocation prescriptions, and program standards. The Forest Service has chosen Alternative Y as the Selected Alternative, and developed this alternative into the Area Plan.

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Executive Summary

I - Document Structure

This Final Environmental Impact Statement (FEIS), prepared by the United States Department of Agriculture (USDA) Forest Service, is required in conjunction with the revision of Tennessee Valley Authority's (TVA) 1994 Natural Resources Management Plan (NRMP). The 1994 Plan served as the Plan of Record covering the operation of Land Between The Lakes National Recreation Area (LBL) in the interim from when the Forest Service (FS) first took over management of LBL until the development of a Forest Service Land and Resource Management Plan. This FEIS discloses and explains the direct, indirect and cumulative environmental impacts that would result from the proposed action and the alternatives developed in revising the 1994 Plan into a Forest Service Land and Resource Management Plan (LRMP) to comply with the National Forest Management Act (NFMA) of 1976 (as amended in 1982). This document is arranged into five chapters, with appendices and index, as follows:

- *Chapter 1 – Purpose and Need for Action:* This chapter includes background information on the legislative actions that brought LBL under Forest Service management; the purpose and need for this action and the proposal for achieving that need; and how the public was informed and their input solicited in this process;
- *Chapter 2 – Alternatives, including the Proposed Action:* This chapter provides a detailed breakdown of the agency's proposed action, as well as alternative methods for achieving the stated purpose. This chapter also provides a summary table showing how alternatives compare to public comments and the issues;
- *Chapter 3 – Affected Environment and Environmental Consequences:* This chapter details the environmental effects of implementing the proposed action, as well as the effects of the other alternatives. This analysis is organized by environmental component and its relation to supporting the overall mission;
- *Chapter 4 – Consultation and Coordination:* This chapter details the List of Preparers and the various agencies who were contacted on the development of this document;
- *Chapter 5 – Glossary, Acronyms and References:* This chapter contains supporting information to provide clarity and definition to the contents of the other chapters;
- *Appendices:* The appendices provide more detailed information, maps, charts or diagrams which support the analyses in this FEIS;

Index: This section contains a listing of the more common words and phrases that program managers, Forest Service employees and the public may use to find specific information within the FEIS.

Additional documentation, including more in-depth background information and detailed explanation of various research and analyses of the planning process to support this FEIS, are in the Project Record Files. These files are located at the Forest Service's Golden Pond Administrative Building at the address listed in the cover to this FEIS.

II - Background

LBL was transferred from TVA to the Forest Service on October 1, 1999, under the provisions of the LBL Protection Act of 1998. The Protection Act calls for the Forest Service to develop an LRMP that complies with the basic laws applicable to all National Forests and will guide management direction for the next 10 to 15 years. The Area Plan describes the public's expectations for desired conditions at LBL and the strategies for achieving them. The Area Plan will not resolve issues in detail, but will provide a general framework by which future decisions will be made.

Beyond transferring management responsibility for LBL, the Protection Act also clearly defines LBL's mission, which is "to protect and manage the resources of the Land Between The Lakes for optimum yield of outdoor recreation and environmental education for the American people. In so doing, to utilize the demonstration assignment to authorize, cooperate in, test, and demonstrate innovative programs and cost-effective management; to help stimulate the development of the surrounding region; and to extend the beneficial results as widely as possible." This mission must be supported by the Area Plan.

III - The Planning Process

As fully described in Chapter Two of the FEIS, the Forest Service took a unique approach in reviewing and analyzing the public comments, existing conditions information, and the potential for future possibilities at LBL. Unlike some planning process techniques, the Planning Interdisciplinary Team (IDT) started by developing small building blocks of potential answers to the needs for change outlined in the NOI, and validated through the public's comments.

Using these building blocks, the IDT began to develop cohesive, plausible alternatives to address the three issues. After substantial and balanced evaluations on the potential benefits and effects of the alternatives, one alternative was chosen as the Selected Alternative. This Selected Alternative was then developed in detail, into the Area Plan, which this FEIS supports.

The analyses of all the alternatives are detailed in Chapter Three. A summary description of each alternative is listed below.

<u>Alternative W</u> – No change would be made from the direction in the 1994 NRMP. Current operational and policy decisions would remain in place. The standards, actions and activities addressed and specified in the NRMP would be implemented. Visitors would notice little or no change.

Alternative X - Management direction toward highly developed facilities with small increases in dispersed opportunities for both Recreation/Environmental Education (Rec/EE). Vegetation management efforts focused on advancing ecological diversity, sustaining the health and viability of the forest and wildlife, and providing vibrant and desirable areas for Rec/EE.

Alternative Y - More dispersed opportunities within the current mix of Rec/EE. The current principle of facility-based EE, and some of the recreation opportunities centered on developed areas, would be complemented by more forest-wide, dispersed opportunities. Existing areas would be evaluated and identified for needed improvements and the potential for realignment into other types of Rec/EE opportunities. No facilities would be developed or reopened. Vegetation management efforts focused on advancing ecological diversity, sustaining the health and viability of the forest and wildlife, and providing vibrant and desirable areas for Rec/EE.

Alternative Z - Decrease the developed Rec/EE opportunities and decrease active forest and vegetation management practices. No new developed areas would be permitted and few, if any, facilities or areas would be reopened. Existing facilities, services, and amenities would be evaluated for potential decommissioning. Forest-wide emphasis would be placed on the non-facility-based EE opportunities and activities, supported by the existing facilities and programs.

IV - Public Involvement

In accordance with the stipulations of the National Environmental Policy Act (NEPA), the Forest Service applied numerous and effective methods in both the public scoping period at the beginning of this Area Plan process, and in the formal draft comment period following the release of the Draft EIS and Area Plan in March 2004.

During scoping, the Forest Service made efforts to hold public forums in the major gateway communities around LBL. The purpose of these was to offer several different formats wherein the public could provide the Forest Service with their concerns, questions, and recommendations for the types and levels of change they would like to see at LBL. In addition to these public forums, two special focus group sessions were conducted to specifically address concerns surrounding two of the three issues – Rec/EE and vegetation management.

At these sessions, a methodology called Appreciative Inquiry (AI) was employed to develop a positive-focused direction for the sessions based on the concerns and important aspects of LBL's management from the public's standpoint. The comments and information gained through these public forums were added to the information gained through the other public forums to help in the development of the four alternatives, Alternative W, X, Y, and Z.

Following the release of the draft documents in late March 2004, the Forest Service began to receive comments specific to the alternatives and the Draft Area Plan. Through the end of June 2004, the Forest Service received close to 300 comments, which were all catalogued, analyzed, and addressed during the draft revision process. All of the public comments received were considered by Forest Service resource specialists or IDT members. The complete set of comments and the responses to them are contained in Appendix A of this FEIS.

V – From Draft to Final

Concerns

At the outset of this Planning process, the Forest Service stressed that this Area Plan would look and be different to the public. Moving away from the traditional, lengthy and difficult-to-comprehend plans, this Area Plan was kept to a minimum-legal, strategic viewpoint in order to make it both timely to develop, and more practical as a management tool for the Forest Service program managers and future personnel at LBL. At the strategic level, the Area Plan describes desired conditions for LBL and the strategies that will be used to move toward those conditions. It also sets limits or boundaries on specific management actions in all program areas and land allocations. This concept is different than some plans the public has seen, and has caused some confusion in its initial release.

The Area Plan does not contain site-specific decisions. The public cannot pick up this Plan and see specific trails the Forest Service will rehabilitate or improve. Nor does it spell out which campsites or areas will be upgraded or enlarged. It also does not say how many acres of forest lands will be treated with pesticides or herbicides.

The fact that the Forest Service was proposing two alternatives for the Recreation and Environmental Education issue was of concern to many people. Comments on this ranged from some feeling the Forest Service was trying to hide something from the public, to others who felt the government wanted to set its own agenda and was trying to confuse the public in order to convolute the comment process.

What the Forest Service was looking for, and got through public comments, was for the public to help the Forest Service determine the best course of action to take on the issues based upon their visions for LBL's future. This information was brought out through the comments received, and ultimately led to the decision to go forward with Alternative Y for the Recreation and Environmental Education issue.

Modifications

Between the release of the Draft documents and the publication of the Area Plan and FEIS, several elements or items underwent refinements based upon various factors. Key clarifications include:

- Renamed the Nature View Demonstration Areas to Nature Watch Demonstration Areas.

- Shifted the boundaries for the northern Nature Watch Demonstration Area as previously published in the Draft EIS and Draft Plan. The area's acreage increased by approximately 1200 acres.

- Renamed the Biosphere Reserve Core areas to Core Areas. Key aspects of this management area remained unchanged.

- Subsequent to the release of the Draft EIS and Plan, and prior to the finalization of the documents, the Forest Service made a management change for the Turkey Bay Off-Highway Vehicle (OHV) Area. The area was converted from open riding to designated trails. This policy decision was made separately from this Planning process and applied equally to all alternatives.

None of these changes was determined to be significant enough to warrant any revision of the four alternatives, or further public involvement.

VI - Summary Conclusion

The Forest Service followed the established legislative guidance in preparing, developing, and producing this FEIS and the Area Plan it accompanies. Every effort has been taken to insure that the information contained in these two documents is fair and accurate, and is based on the best science available, sound land management practices, and the desires and comments received through public involvement. Please direct any questions or comments you may have about the FEIS or Area Plan to the Area Supervisor, whose address is listed inside the cover of this document.

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Environmental Impact Statement
Table of Contents

Chapter 1

PURPOSE AND NEED FOR ACTION

1.1 Introduction

Following the direction given in the LBL Protection Act of 1998, the Forest Service developed an LRMP, or Area Plan, in compliance with the National Forest Management Act (NFMA) of 1976 (as amended in 1982). This FEIS discloses and explains the direct, indirect, and cumulative environmental impacts of the implementation of the Selected Alternative and the other developed alternatives.

1.2 Proposed Action

The Forest Service proposed to revise the existing 1994 Plan into an LRMP in compliance with NFMA. The proposed revision updates the NRMP to comply with NFMA, and establishes the strategic framework to guide and direct all future project-level decisions, actions, and concerns.

This FEIS describes the analysis of several alternatives considered during revision of the NRMP, and discloses the environmental effects of these alternatives. The FEIS is guided by the implementing regulations of NEPA found in the Council of Environmental Quality (CEQ) regulations, Title 40, Code of Federal Register (CFR) 1500. The companion document to this FEIS is the LRMP, or Area Plan, a detailed presentation of the Selected Alternative.

1.3 Decision Framework

Within the context of the Purpose and Need for this action, the deciding official reviews the proposed action, the other alternatives, and the environmental consequences as they relate to the stated mission of LBL. In accordance with 36 CFR 219 dated 1982, the deciding official must make the following decisions:

- *Area-wide multiple-use goals and objectives.* Goals describe a condition to be achieved sometime in the future. Objectives are concise, time-specific statements of measurable, planned results that respond to the goals.
- *Area-wide management requirements.* These are standards and design criteria for management activities or advisable strategies that apply across the entire area.
- *Area-wide direction applying future activities in each allocated area.* This is the desired condition specified for certain portions of LBL, and the standards to help achieve that condition.
- *Lands suited and not suited for natural resource management.*

- *Monitoring and evaluation requirements to gauge how well the Area Plan is being implemented.*
- *Recommendations to Congress, such as Wilderness designations, if any.*

1.4 Public Involvement

Notice of Intent: On June 4, 2003, a Notice of Intent (NOI) to prepare an Environmental Impact Statement (EIS) for revision of the 1994 Plan and establish an Area Plan for LBL was published in the Federal Register. At the same time, the Forest Service released a Planning Background Document (PBD) as a preliminary planning information document, outlining existing conditions of LBL, and highlighting need for change elements within the 1994 Plan to be addressed in the revised LRMP. Subsequent to the NOI, a series of five public scoping sessions were conducted in "gateway" communities surrounding LBL to solicit and review comments and concerns from the communities.

Initial Scoping: Special small group discussions were conducted at each session to develop better understanding of the participants' comments, and to allow for dialogue among the public. Written comments (mail and electronic submissions) and telephone input were received during a 45-day period ending July 21, 2003. During this same scoping period, LBL also asked for public comment on the Forest Service's assessments of the needs for change in the existing management direction.

Focus Group Involvement: Subsequent to this required scoping period, the LBL staff developed and conducted two focused small group discussion sessions to help shape the alternatives. Each session focused specifically on the positive aspects, values, and desire of the two issues which received the vast majority of comments in scoping - Rec/EE and Vegetation Management.

Table 1.4A outlines the dates, locations, participant numbers, and types of sessions conducted as part of formal and informal scoping. Copies of the public notices, which were distributed in support of the scoping process area, as well as summaries of all public scoping sessions are contained in the Project Record.

Table 1.4A – Public Involvement Sessions

Date & Time	Location	Participants*	Type of Session
June 28, 2003 1 to 5 p.m.	Lakeland Jamboree Cadiz, Kentucky	38	Open, small group and "Drop-in"
June 30, 2003 6:30 to 9:30 p.m.	Weaks Community Center Murray, Kentucky	26	Open, small group and "Drop-in"
July 1, 2003 6:30 to 9:30 p.m.	USDA County Extension Offices Benton, Kentucky	25	Open, small group and "Drop-in"
July 10, 2003 6:30 to 9:30 p.m.	Dover Elementary School Dover, Tennessee	75	Open, small group and "Drop-in"
July 12, 2003 1 to 5 p.m.	Lee S. Jones Community Building Eddyville, Kentucky	25	Open, small group and "Drop-in"
August 21, 2003 7 to 9 p.m.	Golden Pond Administrative Building (Forest Service offices) Golden Pond, Kentucky	27	Appreciative Inquiry focus-group process
August 23, 2003, 9-11 a.m.	Brandon Spring Group Center Dover, Tennessee (Forest Service facility)	31	Appreciative Inquiry focus-group process

**** Some attendance numbers are approximations based upon written comments received and the numbers of participants in small groups. The numbers for the two Appreciative Inquiry sessions are exact counts.***

Draft Comment Period: Following the initial scoping period, the Planning Interdisciplinary Team (IDT) combined public comment with existing conditions and the need for change as outlined in the Planning Background Document. The alternatives developed, and the methodology employed in their development, are discussed later in this chapter. The Draft EIS and Draft Area Plan were released to the public on March 26, 2004, which marked the beginning of the formal comment period. The official draft comment period ran through June 30, 2004.

The Forest Service distributed more than 400 copies of the draft documents or their components to numerous public locations (libraries, county executive offices, state and national congressional offices, etc.), as well as to private groups and individuals. Complete details of the entire public involvement process are listed in Appendix A.

Early in this period, the IDT and Leadership Team (LT) scheduled, announced, and conducted four open house public information sessions in gateway communities to provide the public with general guidance and information about the draft documents. The table below outlines the locations, dates and attendance of these four sessions:

Table 1.4B - Draft Comment Period Public Information Sessions

Date	Location	Attendance	Presentations
April 13, 2004	Lyon County HS, Eddyville, KY	43	3
April 15, 2004	Trigg County HS, Cadiz, KY	9	1
April 20, 2004	Marshall County HS, Benton, KY	34	3
April 22, 2004	Stewart County HS, Dover, TN	5	1

Content Analysis: In addition to further scientific review, analysis and evaluations, the IDT and the Forest Service undertook extensive analysis of the public comments received during the formal draft comment period. The Forest Service received 286 responses to the draft documents from across the country in the form of letters, emails, and faxes. The public comments received represent a wide range of viewpoints about the complete spectrum of LBL and the four alternatives evaluated in the DEIS. Each response was reviewed for specific actions that the commenter wanted to see the Forest Service take in preparing the Final Plan, along with any supporting rationale statements about their recommended actions.

The comments received and their analysis proved an invaluable resource to the planning process in helping to maintain a focus on the important and relevant aspects of the direction for this Area Plan and the FEIS. The comments and responses are discussed in Appendix A.

1.5 The Issues

The issues taken into consideration for this revision are the result of preparing the PBD and NOI, and through scoping. Initial issue items detailed in the NOI and PBD were validated during the 45-day scoping period, and through general public comments received in relation to the NOI. All comments received were designated as either relevant to one of the issues, or outside the scope of the Area Plan. The public also tacitly supported the conclusions of the PBD.

Based upon the existing conditions of LBL, the management direction given through the 1994 Plan, and analysis and review of the scientific data and public comments, the following issues and relevant items were established.

Planning Issue 1 – Recreation and Environmental Education: How will LBL best manage resources for the optimum yield of outdoor recreation and environmental education?

- The main recreational issues at LBL are related to the volume, location, and long-term sustainability of each type of activity. A mix of active and passive, motorized and non-motorized, and developed and backcountry activities are currently permitted at LBL.

- The distribution and balance of elements within the recreation program, and the question of whether to increase or decrease specific opportunities, will be reviewed through public input and study of current scientific documentation. This assessment will examine current and anticipated user demands and help identify areas of potential change or improvement.
- A secondary part of this element is one of appropriateness in relation to the mission of LBL. In particular, this encompasses the relation of the mission to fees, profit, and competition with area businesses. Former residents have specifically commented on this facet of LBL's management.
- How to integrate environmental messages into every program at LBL, including recreation, forestry, and fish and wildlife management.
- Determine if there is a need for more or fewer developed environmental educational facilities (buildings, exhibits, and interactive trails).
- Identify and establish the appropriate perspective and direction for formal and non-formal environmental education efforts:
    - Formal efforts are centered around groups, educators, and classroom programs that foster a classic and academic value toward conservation;
    - Non-formal efforts are geared toward families and individuals in dispersed 'natural' learning settings that foster a personal conservation ethic.
- Identify cultural and/or natural education goals to meet public demand.

Planning Issue 2 – Vegetation Management: How will the vegetation on LBL be managed and what desired conditions would contribute best to the optimum yield of outdoor recreation, environmental education, and stimulation of regional economies?

A primary component of a healthy ecosystem, and in turn, the health and viability of wildlife habitats, the level of enjoyable and sustainable outdoor recreation, and the quality of environmental education programs, is the health and management of the forests. Of equal significance, but much smaller in total area, is the management and overall health of the open lands, riparian and wetland areas.

For vegetation management, there are several relevant health indicators and management considerations that the Area Plan will take into account. These include, but are not limited to: oak decline; forest species composition and viability; old growth; open lands management and distribution; prescribed fire and silvicultural treatment methods.

- LBL is primarily composed of oak species (80 percent of the total forested acreage). As the overstory of these oak stands continues to age, there will be an increased risk of incidence of oak decline:
    - Oak decline, as a condition or state of a forest, results from inadequate management measures of both existing oak stands and new growth;
    - Oak decline not only occurs from aging, but also as a result of environmental stresses such as drought, insect defoliation, site limitations, or a combination of these effects.
- Trend data from the past 30 years from LBL's Continuous Forest Inventory (CFI) indicates a shift in species composition over all of LBL. According to CFI, more maple and poplar, and less species of the red oak group could be the future composition of the mesophytic forest areas within LBL.

- Open land comprises about 6 percent of the total land base. Managing the five categories of open lands (cooperative farming, woods openings, wildlife plantings, other (reverting) open lands, and miscellaneous lands) will be integral in sustaining multiple-use recreation and in supporting environmental education programs and potential.
- Prescribed burning may be used as a necessary method to regenerate oak and pine stands, manage for herbaceous understory and wildlife habitat, maintain and restore fire dependent plant communities, reduce leaf litter in recreation areas, and reduce undesirable vegetation in open lands.
- Old growth - While there is no clear definition of old growth in the 1994 Plan, LBL currently employs the Forest Service Region 8 (R8) Guidelines for Old Growth. These guidelines need to be followed for old growth designation and delineation. The Core Areas are the most likely acres within LBL that would be selected for old growth.

Planning Issue 3 – Special Designations: Should areas with special management designation continue to be managed under these designations or be changed? Should additional areas be designated for special management?

It is a NFMA requirement that LBL conduct an inventory of areas suitable for special designations and consider making recommendations in the Plan for Wilderness or Roadless designation. LBL currently maintains approximately 42,500 acres designated as Core Areas. These areas generally include Research Natural Areas and Ecological Study Areas located in various points across LBL.

1.6 Planning Process Records

Additional documentation, including more in-depth background information and detailed explanation of various research and analyses of the planning process to support this FEIS, are in the Project Record files. These files are located at the Forest Service's Golden Pond Administrative Building at the address below:

Area Supervisor's Office
Land Between The Lakes National Recreation Area
100 Van Morgan Drive
Golden Pond, Kentucky 42211
270-924-2000

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Chapter 2

ALTERNATIVES, INCLUDING THE PROPOSED ACTION

2.0 Introduction

In contrast to the methods other Forest units have used in alternative development, the IDT developed individual management strategies to address each of the three issues established through scoping and initial analysis. Each of the issues was analyzed as a single topic, rather than being analyzed together under predetermined themes. The end result gave the Planning Team a set of management 'building blocks' specific to each of the issues, which could then be used in constructing individual alternatives. This approach focused the planning process on dealing strictly with the identified 'need for change' aspect of the issues.

Three "building blocks" from each issue were then combined into alternatives and identified by themes. In some cases, the blocks did not fit with each other in terms of principle or direction, and could not be combined to form a reasonable alternative. Combinations that fell outside the law, were not in keeping with the purpose of LBL, or were not validated by the public, were not carried forward for detailed analysis. Other obvious combinations of blocks emerged, which helped the team develop the four alternatives discussed in this chapter. Significant direct, indirect, and cumulative effects were determined for each of the four alternatives.

2.1 Alternative Building Blocks

The building blocks that were developed for this process are listed below by the issue to which they pertain:

Issue #1 – Recreation and Environmental Education (EE)
<u>Rec/EE Building Block A: Non-Facility-Based Environmental Education Focus; Reduced Emphasis on Developed Recreation Amenities and Services</u>

The focus of this block is to create an environmental education (EE) platform that places emphasis on non-facility-based opportunities. This option also provides for a decrease in the levels and types of services and amenities offered or provided at highly developed recreational facilities.

Non-facility-based opportunities would be the driving element of EE, supported by the established EE facilities. Environmental education facilities would be evaluated, and improved if necessary, to reflect advancements in educational and interpretive methods and environmental sciences. No new highly-developed facilities would be added, and no net increase in operational EE facilities would occur in this option. As an example, if Youth Station were reopened, another EE facility would be closed. The non-facility-based EE activities and efforts would focus on the goal of delivering appropriate and targeted EE messages and information to every LBL visitor. New non-facility-based EE sites, areas, trails, and programs would be developed based upon user demands and to raise environmental awareness.

Highly developed recreational areas and facilities such as Hillman Ferry, Piney, and Wranglers campgrounds, and Turkey Bay Off-Highway Vehicle area, would be reduced in scope in terms of the levels and types of the amenities offered. The extent of the services provided at all developed facilities would be scaled back as a means of creating a less developed recreational environment. Little change would be expected at lake access, day-use, and other dispersed recreation areas. The overall fee structure for all recreation and EE facilities and opportunities would be focused on significant reductions based upon the extent and level of services or amenities provided at all facilities or areas. This amounts to a trade-off between a reduction in fees for a reduction in services and amenities, and a commensurate reduction in recreation opportunities.

Rec/EE Building Block B:
Increase in Facilities and Scope of Recreation and Environmental Education

The focus of this block would be to provide increased recreation and EE opportunities and programs through development of new facilities and areas while remaining consistent with the requirements of the Protection Act. These opportunities would be similar to existing opportunities currently offered at LBL, such as developed campgrounds, lake access private areas, trails, environmental education facilities, etc. Highly-developed commercial facilities such as marinas, condominiums, golf courses, or similar sites that would be in direct competition with regional businesses and inconsistent with the mission of LBL, would not be considered.

Current recreational facilities, including campgrounds, lake access areas and boat ramps, trails, and developed day-use areas, would be improved to provide more of the facilities and amenities that users of those areas have requested. Potential new recreational facilities and areas would be evaluated for development and expansion as future recreational demands indicate, although no new level five campgrounds or outposts would be considered.

The facilities for EE would be evaluated for expansion within their current areas. New areas would be identified for development or reopening based upon several factors, including: established objectives to provide environmental messages, information and education to visitors, new technologies in environmental sciences, advancements in educational delivery methods, and visitor demands. Non-facility-based EE efforts would be expanded through development of sites, trails, areas, and programs to meet the growing demand for these types of experiences.

Fee structure for expanded and new facilities or services would be evaluated in conjunction with operational costs. Preference would be given to reducing the EE fee structure, in combination with appropriate and acceptable increases in the "specialized use" recreation fee structure. Any fee re-structuring would keep services on LBL at a non-competitive level with surrounding communities, and considerate of disadvantaged or underprivileged sections of the public.

Rec/EE Building Block C:
Increase in Non-Facility-Based Environmental Education and Dispersed Recreation Opportunities with Trade-offs

This building block focuses on providing for an increase in non-facility-based EE and dispersed recreation opportunities. Management direction under this block would support potential significant adjustments in the amenities and services now offered at existing developed facilities. This would also allow for possible realignment of existing developed areas to better meet public demand for dispersed opportunities, and to offset operational costs.

Non-facility-based EE activities and opportunities would be given an increased priority compared to current levels through an area-wide focus that is more obvious within prescriptions and the resulting management of those areas. Some prescriptions would have a primary emphasis to provide non-facility-based EE activities and incorporate the other resource management activities of the area as components of the program. An example might be nature-viewing or wildlife management areas that could use, as much as possible, existing programs (e.g. Nature Watch) that integrate recreation, education, and conservation components.

Dispersed recreational opportunities and areas would be expanded to provide more balance in overall recreational opportunities. Examples of dispersed expansion could include, but not be limited to: swimming beaches; converting a lake access area emphasis from overnight camping to day-use recreation; and shoreline fishing areas.

Highly developed recreation and EE facilities and areas would be evaluated for possible improvement, realignment, or reduction in order to meet optimum efficiency in the operation of facilities. Improvements made to existing developed facilities would be done within current facility boundaries. No net increase in the number of facilities would be permitted under this block. Examples of these improvements or realignments would be increasing the number of electric camping sites at campgrounds or redesigning EE exhibits or facilities to better support educational objectives.

Fees across LBL for EE and recreation would also be evaluated for realignment or reduction in conjunction with the dispersed activities and the quality of the programs and exhibits. The quality and value of the programs and exhibits, effects on visitation, impacts on underprivileged or disadvantaged persons, and operational costs would be the determining factors in establishing a revised fee structure for all recreation and EE opportunities.

Rec/EE Building Block D:
No Change

Under this block, the management practices and guidelines from TVA's 1994 Plan and current policy would be continued. No new facilities would be added under this block, and no significant changes to existing services or amenities would be expected. This option would allow for the localized expansion of existing "specialized use" facilities or programs based upon visitor increases, user demands and resource capabilities, or to accommodate developments in Rec/EE opportunities on a regional or national level.

Issue #2 – Vegetation Management
Vegetation Management Building Block A:
Enhancing Ecological Diversity

This building block would focus on actively managing our land and water resources to support and enhance wildlife and outdoor recreation opportunities across LBL. This will include looking at the composition, structure, spatial distribution, and physical characteristics of our forested and open land areas to meet our forest health and species viability needs. This may be accomplished by reallocating some open land acres to forest in selected areas and reclaiming or creating openings in other areas with no net loss of early successional habitat; changing the composition and abundance of open land types; and implementing prescribed fire on a larger landscape scale than has been done since adopting the 1994 Plan. The enhancement of forest health and species viability would remain the priority over other management elements where conflicts occur that cannot be mitigated.

Ecological diversity may be enhanced through various methods of active management. The historical management of the land resources in LBL and proven techniques will be considered in determining the types of treatments.

The treatment methods may include, but are not limited to: prescribed fire; selected minimal management; forest management to increase or decrease forested acres; some conversion of open lands to grasses; mowing and grain cropping; and other proven methods of treatments such as the use of herbicides.

This block would consider that a percentage of open land acres would be gradually converted and restored to natural vegetation types that include native warm season grasses and forb species. Open lands could be cropped. The treatments determined to create and maintain these conditions would support and maintain forest health, species viability, water quality, and improved soil productivity and stabilization.

This block would also consider how forest composition and structure would be maintained in oak-hickory forest types. The treatments that would be considered would provide for open forest canopy conditions and open lands maintained primarily in natural vegetation types for a variety of viewing opportunities. Viewing opportunities for some forms of wildlife would be limited due to their ability to hide in tall grasses.

Vegetation Management Building Block B:
Minimal Vegetation Management

Under this block there would be a limited application of those activities and treatments determined necessary to maintain forest health and species viability, to control epidemic outbreaks, to provide visitor safety, and maintain utility and vehicular access right-of-ways. The focus of this building block would be to allow a large percentage of the vegetation across LBL to develop unrestricted and unmanaged as much as possible.

The passive management option would promote the reversion of open lands to forest and forest cover types aging to old growth beyond the lifespan of this Area Plan. Recreational and environmental education opportunities would be secondary to vegetation management to decrease the effects of human intervention and occupation in both developed and dispersed areas.

Vegetation Management Building Block C:
No Change

Under this block, the management practices and guidelines from TVA's 1994 Plan would be continued as they were planned. No significant increase or decrease of timber management, or changes to open lands, wetland, and riparian areas would occur.

Issue #3 – Special Designations
Special Designations Building Block A:
Recommendation for Wilderness and Roadless Areas within Core Areas

The focus of this block is to recommend part of the southern portion of the LBL Core Area for wilderness study if an area meets roadless criteria. Part of the evaluation leading to this wilderness recommendation will examine possible road closures or rerouting to accommodate management of a roadless area. All other Special Designations would be managed under the current Area Plan guidance.

Special Designations Building Block B:
No Change to the 1994 Plan

Current Core areas and other special areas, such as Research Natural Areas, would maintain total acreages and current management activities.

2.2 The Alternatives

Using the elements described in the building blocks, the IDT carefully evaluated various combinations in developing potential management avenues. Several combinations of blocks were disregarded based upon the contradictions inherent between two or more of the blocks. The combinations of blocks that did have similarities, and did fit together in principle, were then identified by common approaches or themes within the blocks.

As part of the public comment process, an invitation was made to the public to submit an Alternative Management theme. Concurrent with the Planning Team's development process, a citizen's group, representing the interests and concerns of some of the former residents and other "no development" advocates, provided input, comment, and potential management direction they would prefer. Their proposal contains some elements of the previous Area Plan content, as well as their long-standing position of less active management and no fee-based activities, which they feel needs to be considered for the future of LBL.

NFMA regulations at 36 CFR 219.12(f)(6) require the Forest Plans to respond to and incorporate the Renewable Resource Planning Act (RPA) Program objectives. The last RPA Program was developed in 1995. Currently the Forest Service Strategic Plan (2000 Revision) provides broad overarching national guidance for forest planning and national objectives for the Agency as required by the Government Performance and Results Act. All of the alternatives in this FEIS incorporate these broad strategic objectives.

Based upon the Need for Change, the comments and issues raised and validated through scoping, the Team has developed four Alternatives. A simple comparison of the Alternatives is displayed in Table 2.2.A. Table 2.2.B follows the narrative descriptions of the Alternatives, and shows the relation of the Alternatives to the range of public comments we considered.

Table 2.2A – Alternative Management Development Matrix

Alternatives / Building Blocks	Alternative W *"No Change to the 1994 NRMP"*	Alternative X	Alternative Y	Alternative Z
Rec/EE A Increase non-Facility-Based EE, Reduce Recreation Amenities and Services				**XX**
Rec/EE B Increase facilities for Rec/EE; develop a supporting fee structure		**XX**		
Rec/EE C Increase in Dispersed Recreation and Non-Facility-Based EE opportunities; match fees to value			**XX**	
Rec/EE D No Change	**XX**			
Veg Mgt A Improve Ecological Diversity		**XX**	**XX**	
Veg Mgt B Less Active Management				**XX**
Veg Mgt C No Change	**XX**			
Spec Des A Recommendation for Wilderness, if requirements met				**XX**
Spec Des B No Change	**XX**	**XX**	**XX**	

2.2.1 Alternative W – No Change to Current Policy and the 1994 Plan

This alternative is required under NEPA. It provides for no significant change from the current management of Rec/EE facilities, areas, or opportunities. Similarly, it has no significant change in the vegetation management of the forest or open lands across LBL. Current management options for all facilities, areas, and treatments remains the same. Individual project or program decisions would be guided by the parameters established in TVA's 1994 Plan, as amended by the analysis under NFMA for this revised Area Plan.

Desired Condition: LBL would be managed for approximately 89% oak-hickory forest cover. Timber removals may be used to enhance habitat, improve forest health, or maintain scenic drives. Although timber removal levels will remain at the levels in the 1994 Plan, visitors may perceive timber levels to increase in this alternative since the Forest Service has not removed timber since the transition from TVA. Open lands management would appear unchanged except for areas of successional growth and continuing efforts of warm season grass restoration. Environmental education opportunities would be available at staff-based developed facilities, with some self-guided experiences. Campers may see improvements to highly developed campgrounds. Roads and trails would be maintained.

2.2.2 Alternative X

This Alternative would give management direction toward highly developed facilities with small increases in dispersed recreation and non-facility-based environmental education. Vegetation management efforts would be driven toward the goal of advancing ecological diversity, sustaining the health and viability of the forest and wildlife, and providing vibrant and desirable areas for Rec/EE.

Under this Alternative, management guidance would provide for new or improved developed recreation facilities, the possibility of reopening closed facilities, expansion of environmental education facilities and areas, and an increase in the number and types of trails and other dispersed recreation opportunities and non-facility-based EE experiences. Existing developed facilities would be evaluated for improvements to provide a wider range of opportunities for environmental education and recreation at LBL. This Alternative would allow for evaluations and modifications to recreation and EE facilities and areas to accommodate future advancements in both disciplines, as well as potential demand.

Vegetation management would take an active posture in providing a wider range of forest types and compositions across LBL to support a variety of wildlife, ecological and recreational objectives, and requirements. Timber removal would be kept at about the same levels as allowed in TVA's 1994 Plan. Open lands and forested areas would be evaluated for realignment or redistribution of acreages based upon scientific analysis, to sustain overall forest health, support species viability, and provide wildlife habitats as necessary. Management direction for vegetation would be expanded to allow for a wider range of proven management techniques to be applied to the vegetation across LBL.

Concurrent with the implementation of these developments would be an evaluation of the fee structure for both recreation and EE. The quality and value of facilities and programs would be a significant determining factor in developing an equitable but sustainable fee structure. This would also factor in visitation, disadvantaged and underprivileged populations, and public demand for these experiences. Any increase in recreation and EE opportunities would require commensurate savings, efficiencies, or alternative procedures to stay within planned operating budgets.

Desired Condition: There will be an increase and upgrading of staffed facilities designed to enhance visitor experiences in targeted recreational and educational activities. The focus will be on providing more facility-based experiences and amenities. Visitation is expected to increase, and uses will be intensified.

Natural resources in heavy use areas are hardened to withstand projected impacts. Opportunities in dispersed recreation and non-facility-based EE will focus on extending the offerings of the highly developed facilities. Remote recreational opportunities will be provided in the Core Areas.

Vegetation management to achieve a healthy, primarily oak-hickory forest type and open grasslands might be visible to visitors at LBL. The forest would be managed to maintain a healthy condition with reduced risk and damage from insects and diseases, invasive species, and fires. Scenic views and vistas are maintained and enhanced. Fields may be managed for conversion to native warm and cool season grasses and forbs. Prescribed fire may be utilized on a larger landscape scale than has been used recently. Projects that create suitable critical habitat for species of viability concern and associated communities are favored.

Land allocations will favor those prescriptions that support developed recreation opportunities.

2.2.3 Alternative Y

The focus of this Alternative is to establish a more dispersed level of opportunities within the current mix of recreation and EE. Under this Alternative, the current principle of facility-based EE, and some of the recreation opportunities centered on highly-developed areas, would be complemented by more forest-wide, lesser-developed, dispersed opportunities in both disciplines. Existing areas would be evaluated and identified for needed improvements, as well as the potential for realignment into other levels of recreational development and types of EE opportunities. No current facilities would be closed, and no new high-level facilities would be developed or reopened.

Within this Alternative, total recreation and EE opportunities would not be decreased in any way, and the mix of each would actually be enhanced through dispersion. Dispersed recreation opportunities would support and extend the reach and effectiveness of the EE programs and facilities by exposing more visitors to EE information and awareness messages and themes. Within this Alternative, management direction would allow for realignment of some areas to different recreation opportunities.

Vegetation management under this Alternative would provide for improvements to the ecological diversity of LBL through a wide range of proven and appropriate management methods. While some of these methods are already stipulated under the 1994 Plan, several are not. In order to sustain the overall health of the forest, and for both wildlife habitat and an enriched recreation or EE opportunity, a broader range of acceptable vegetation management options would be necessary. Timber removal would be kept at about the same levels as allowed in TVA's 1994 Plan. These practices and methods would provide the means to realign some acreages within LBL in order to: sustain or create early successional growth; promote better open lands management and distribution; to improve species viability and game species management; and to implement and promote reversion of some maintained open lands into young forest growth and conversion of some cropped lands to warm season grasses.

This Alternative would direct a concerted effort to align the fee structure for recreation and EE to provide for an appropriate balance of opportunities and fiscal viability. Every effort would be examined to reduce fees where appropriate that could be sustained through reductions in what the programs or facilities offer. Emphasis would be placed upon the quality and value of the programs and services over simply reducing fees.

Desired Condition: Opportunities for visitors to participate in a wider range of self-guided recreation and education activities would be developed. Areas may be redesigned or consolidated to allow for greater diversity of targeted activities. Management activities will focus on providing more successful nature viewing opportunities for novice observers. More miles of loop trails might be created. Environmental education components will be incorporated into natural resource management activities occurring across LBL. Remote recreational opportunities will be provided in the Core Areas. Visitation is expected to slightly increase, and recreational use will be dispersed. Natural resources in heavy use areas are hardened to withstand projected impacts and policies limit use well below sustainable levels.

Vegetation management to achieve a healthy, primarily oak-hickory forest type and open grasslands might be visible to visitors at LBL. The forest would be managed to maintain a healthy condition with reduced risk and damage from insects and diseases, invasive species, and fires. Scenic views and vistas are maintained and enhanced. Fields may be managed for conversion to native warm season grasses and forb species. Prescribed fire may be utilized on a larger landscape scale than has been used recently. Projects that create suitable critical habitat for species of viability concern and associated communities are favored.

Land allocations will favor those prescriptions that support dispersed opportunities.

2.2.4 Alternative Z

This Alternative presents the philosophy that, over time, undeveloped and primitive areas will become very rare, and hence, more socially significant, particularly in this part of the country. In time, more and more people will be drawn to visit this “green” oasis. A local citizen’s group provided many key parts of this alternative.

The focus would be to decrease the highly developed recreation opportunities across LBL, as well as decrease active forest and vegetation management practices. Staff-led, facility-based EE activities would likewise be de-emphasized. No new developed areas would be permitted under this Alternative, and few, if any, facilities or areas would be reopened. There is interest in trying to reopen several sites, but appropriate and offsetting trade-offs would be required in order to operate LBL within fiscal constraints. Existing facilities, services, and amenities would be evaluated for potential decommissioning. This option would place forest-wide emphasis on non-facility-based EE opportunities and activities supported by the existing facilities and programs.

Vegetation management would be limited to those activities necessary to maintain road and utility right-of-ways, for the safety of visitors and staff, and for maintenance and access of developed facilities, roads, and trails. The forested and open lands of LBL would be allowed to develop, through natural progression, through the various growth stages with almost no management methods applied to these areas. A portion of the Core Area in the southernmost part of LBL would be recommended for designation as Wilderness and Roadless, if qualified, which would provide a more remote recreational and environmental education opportunity for visitors. Management activities that would be allowed would be restricted to maintenance of existing recreation, EE, and administrative areas that remain open.

Fees would be reduced or eliminated under this Alternative commensurate with the decrease in both developed recreation and EE opportunities and facilities. The feasibility of reducing or eliminating fees and resulting operational changes would be dictated by the ability of the Forest Service to maintain and operate these facilities to provide a valued experience in a safe, sustainable manner.

Desired Condition: Visitors to LBL will observe less noticeable active management by the Forest Service. Visitor environmental education would be focused much more on personal discovery and less on facility based, guided interpretation. Areas of LBL are focused on viewing nature and natural conditions. Additional limited hunting areas may be established to allow for improved wildlife viewing and hiking opportunities and to avoid user conflicts. Management activities will be focused on providing more successful nature viewing opportunities for novice observers. More remote recreational opportunities would be the primary form of recreation, with fewer highly developed opportunities available. Services such as rentals and outposts might be scaled back at developed campgrounds. Quality “wilderness-type” experiences such as solitude and primitiveness would be provided. Many of the existing open lands would revert to forest, primarily in areas that are contiguous with large forest blocks. Forest cover types are typically aging to old growth beyond the lifespan of this Area Plan. Vegetative management and timber removal would be minimal and limited to needed activities for significant forest health and scenery management objectives. Other than critical habitats needed for Proposed, Endangered, Threatened, and Sensitive (PETS) species, wildlife habitat and associated communities will begin to adjust to that which is favored by the resulting ecosystems. Prescribed fire will be used to mimic natural processes primarily in open lands and recreation areas but very little in forested landscapes. Land allocations will favor those prescriptions that support dispersed opportunities and less active management. An increase in the number of acres allocated to semi-primitive, non-motorized experiences is envisioned.

Table 2.2B – Alternative Comparisons in relation to public comments

Comment/Concern	Alt W *No Change*	Alt X	Alt Y *Selected Alternative*	Alt Z
Recreation, Environmental Education:				
- New Facilities	**No**	**Yes**	**No**	**No**
- Improve or Upgrade Facilities	**Yes**	**Yes**	**Yes**	**Maintenance only**
- Reopen facilities	**Little Potential exists**	**Potential exists, but improbable**	**No**	**Study; with trade-offs possible but improbable**
- Realign or change designations, opportunities	**No**	**Yes**	**Yes**	**Yes**
- Close facilities	**No**	**No**	**No, but the designations of some may change**	**Potential exists**
- New trails	**Maintenance only**	**Yes**	**Yes**	**Yes**
- Wilderness recommended	**No**	**No**	**No**	**Yes, if evaluation supported recommendation**
- Outpost and similar amenities	**Yes**	**Yes**	**Yes**	**Reduced**
- Hunting, fishing opportunities	**No change**	**Potential for increase**	**Potential for Increase**	**No significant change**
- Cultural, heritage sites noted in 2003 Heritage Resource Mgt Plan (HRMP) (cemeteries, etc.)	**No change**	**No change**	**No change**	**No change**
- Fees	**No change**	**Evaluate for appropriate decrease or increase**	**Evaluate, lower if possible**	**Reduced significantly**
- Private development (marinas, golf courses, home sites, etc.)	**No**	**No**	**No**	**No**

Table 2.2B (Continued)

Comment/Concern	Alt W *No Change*	Alt X	Alt Y *Selected Alternative*	Alt Z
- Quality, Value of Rec-EE programs, services	No change	Significant increase, tied to fees and costs	Moderate Increase, tied to fees, costs	Increase volunteer efforts, contributions
- Wildlife Viewing	No change	No change	Develop Nature Watch North and South areas	Develop Nature Watch North and South Areas
- Elk and Bison Areas	No Change	No Change	No Change	No Change
Vegetation Management				
- Timber harvest	No change from 94 plan	Similar to 94 Plan levels	Similar to 94 Plan levels	Less than 94 Plan
Expected Timber Harvest Acres per year	2100	2200	2200	1200
- Open Lands Reversion	No	Some; potential redistribution	Some; potential redistribution	Some Interior reverts naturally
- Old Growth	Yes, Forest Service inventory needed	Yes, Forest Service inventory needed	Yes, Forest Service inventory needed	Yes, Forest Service inventory needed
- Oak-Grassland Demo Area	None designated	North and South Areas	North and South Areas	None designated
- Prescribed fire, herbicide/pesticide practices	Per the 94 Plan only	Yes, to support ecological diversity, wildlife habitats, and Rec/EE areas	Yes, to support ecological diversity, wildlife habitats, and Rec/EE areas	Yes, Less than X or Y

2.3 Alternatives and Building Blocks Not Carried Forward

When you consider the total number of blocks developed, the Team could have possibly developed a total of 24 different Alternative combinations. The majority of the building block combinations, however, were quickly discounted based upon major inconsistencies or inadequacies produced by the combinations themselves. All combinations developed could readily be placed into one of four categories:

(1) Reasonable, proper, and appropriate combinations to consider in addressing the Issues;
(2) Outside the scope of law applicable to the Plan Revision (including the stated purpose of LBL);
(3) No significant difference between "No change" Alternative or another combination that better addressed the issues or need for change;
(4) Combinations obviously impractical or unreasonable to implement or whose building blocks were in conflict with other blocks in the same combination.

The possible combinations in the latter three categories listed above were dropped from further consideration. The complete listing of building block combinations that were not considered is displayed in a table of Appendix A.

Public Input Considerations

Some comments submitted by the public in relation to the issues were not developed or carried into the building block phase. These comments, regardless of number or merit, were not carried forward for the same reasons as stated above, including that they addressed an issue at a project or program level rather than the strategic planning level. Other comments received were not explored further in the building block phase because they did not support the mission of LBL, or because they would not be feasible or reasonable to implement at the Plan level for environmental, fiscal, logistical, health or safety purposes. Several comments considered, but not developed into an alternative, were in conflict with regional or national wildlife conservation strategies already underway.

The range of comments that fell into these categories generally included suggestions, concerns, or recommendations as follows:

- Decreasing and removing a majority of the infrastructure for recreation or administration;
- Eliminating all forms of vegetation management, specifically timber cuts of any kind;
- Eliminating all fees for all facilities, programs and events, including all types of user-defined services such as the outposts, gift shops, access fees, ice machines, permits, and rentals of any kind at the campgrounds;
- Allowing OHV and horseback riding all across LBL;
- Eliminating all forms of hunting;

- Allowing large-scale development for major businesses such as marinas, home sites, golf courses, etc;
- Reintroducing other endangered or extirpated wildlife formerly native to the area (red wolf, in particular);
- Allowing the elk and bison to roam freely across LBL.

Internal Proposals Addressing Public Input

Some consideration and discussion was given to proposed management direction for the issues that did not become part of the blocks or the Alternatives in the final phase of development.

In particular, one approach to vegetation management was discussed at length and examined in relation to how it addressed the issues and public comments. In this block, the management practices would have guided the makeup of vegetation toward conditions that existed on LBL prior to the 1700s. Public comments along these lines tended to place more emphasis on a hands-off, unmanaged approach to the vegetation practices to foster natural growth, regeneration, and reversion across LBL. The block, as it was written and proposed prior to being removed from consideration, read as follows:

Vegetation Management Building Block D:
Gradual Conversion and Restoration Management

This block would consider that a large percentage of open land acres would be gradually converted and restored to natural vegetation types that include native warm season grasses and forb species. This would mean a gradual elimination of crop and hay fields and many of the current wildlife plantings.

Forest composition and structure would be maintained in oak-hickory forest types to represent forest conditions prior to European settlement as much as possible. Prior to European settlement the American Indians burned fields and forests for a variety of reasons, used wood for fuel, and as a result the forests were converted to open woodland and grasslands. The treatments that would be considered would provide for open forest canopy conditions and open lands maintained primarily in natural vegetation types for a variety of viewing opportunities. Viewing opportunities for some forms of wildlife would be limited due to their ability to hide in tall grasses.

Forest management activities may be more extensive than proposed under Block A. Open lands could be cropped. The treatments determined to create and maintain these conditions would support and maintain forest health, species viability, water quality, and improved soil productivity and stabilization. Treatments used would include but would not be restricted to prescribed burning, forest management, mowing, herbicide use, and open land grain cropping.

This block would have involved the use of management practices and tools with substantial impact to accomplish the following:

- Provide conditions that promote natural reversion of open lands to early successional forests;
- Incorporate practices such as understory prescribed fire to regenerate fire-dependent native plants and undergrowth, and use age-specific timber harvesting to create more open forests with older-age coverstory to promote wildlife habitat (both practices were used by American Indians prior to European settlement of the area);
- Reduce the acreage of croplands currently managed to provide for more natural reversion of open lands to native warm-season grasses and wildflowers;
- Actively apply timber harvests to cultivate more old growth oak-hickory areas.

After detailed and lengthy discussion and consideration of the effects and impacts on Rec/EE, this building block was dropped from consideration. However, some portions of the management practices from this block were incorporated into Vegetation Management building block A and considered in developing the alternatives.

Alternative Directions Eliminated From Detailed Study

Among the proposed Alternatives of the FEIS there are several building block elements that offer significantly different or opposite direction for the issues. There are some other significantly different or opposite management directions that were not included in the Alternatives or the building blocks. Many of these elements or management options were not voiced through public comments, however the few that were are not being considered in detail because they would eliminate or substantially degrade the multiple use benefits for which LBL was established. Some of these options not carried forward include:

- Decreasing Environmental Education;
- Decreasing dispersed Recreation opportunities or areas;
- Eliminating any areas with Special designations;
- Closing Turkey Bay Off-Highway Vehicle (OHV) area;
- Restricting or eliminating equestrian activities from Wranglers Campground.

As it is written, TVA's 1994 Plan is not an Alternative that can be carried forward for consideration. The format, requirements, and legislative requirements for the Forest Service are different than those for TVA when TVA's 1994 Plan was approved. The current management of LBL uses the 1994 Plan as its basis, along with practices and objectives set forth in the LBL Protection Act of 1998. Alternative W, the No Action Alternative, captures the combination of these two directives in a single document.

2.4 The Selected Alternative

Based upon the subsequent assessments, analysis, and comparisons of the effects on the environment and resources, the Forest Service chooses Alternative Y with slight modifications as the Selected Alternative.

Alternative Y best meets the needs of the public and the environment as it relates to the issues of Recreation and Environmental Education, Vegetation Management, and Special Designations. This choice provides a balanced mix of goods and services that provide important net benefits to the visiting public as well as the local and regional communities that surround LBL. The Area Plan details the Vision, Strategy and Design Criteria to be implemented through future management and projects through this Alternative.

2.5 Comparative Analysis of the Alternatives

During the course of evaluating and developing the alternatives and effects analysis, the alternatives were closely examined and delineated by the amount of change they each contained relative to the current management scenario, or No Change (Alternative W). This refined analysis helped to focus the Forest Service resource specialists in determining the extent to which the management practices or activities could be applied to guide the resources of LBL toward the desired conditions of each Alternative.

The results of this intensive analysis and comparison of the Alternatives is outlined in Table 2.5A. It helps to highlight the significant differences in the actual management practices and desired outcomes, as well as the shifts in the principles by which future practices would be applied. The significance of the principle also constitutes a significant change from the No Action Alternative, even if the actual management practices do not appear significantly different. Descriptions of the prescriptions in Table 2.5A can be found in Appendix D.

These shifts in principle are found primarily in the Vegetation Management areas for the general forests and in the land allocation areas. The practices and principles highlighted in Table 2.5B reflect these significant changes between the Alternatives and the No Action Alternative (W). It also helps to point out the comparative differences and benefits that each has to offer in relation to addressing the need for change and issues.

In forest plans, the land allocations are described using prescriptions. The prescriptions and acres for LBL under each alternative are listed in Table 2.5B and described in detail in Appendix D. The prescription areas are also mapped for each Alternative in Appendix I.

Table 2.5A - Alternatives Comparison By Issues, Allocations and Prescriptions

NOTE: Blank spaces in the Table indicate no change from current management direction

Summary of Alt by Element	Alt. W *No Change*	Alt. X	Alt Y *Selected Alternative*	Alt Z
ISSUES				
Recreation/Environmental Education		More upgrades & facility focus	More dispersed focus	Fewer amenities and fees
Vegetation Management		Improved Ecological Diversity	Improved Ecological Diversity	Less Intensive Management
Special Designations		Deferred area conversions	Deferred area conversions	Recommend Wilderness if criteria met; Def. area conversions
PRESCRIPTIONS				
Natural Resource Stewardship				
General Vegetation (forests/open lands)		Reallocate, restore, redefine	Reallocate, restore, redefine	Some reallocation
Core areas	Approx 35,000 acres Large and medium blocks same as 94 Plan	Approx 41,000 acres from deferred General Forest	Approx 42,000 acres from deferred Gen. Forest & Dev. areas	Approx 46,000 acres Designate all deferred acreage
Oak-Grassland Demo Area		N. & S. Areas	N. & S. Areas	
Wetlands Management				
Wildlife Refuges				
Administrative Areas				
Utility Corridors				
Admin, Maintenance, Closed Facilities		Consolidate	Consolidate	Consolidate
Communication Sites				
Roads		Improve/upgrade	Improve/upgrade, fewer miles	
Recreation/Environmental Education				
Developed Recreation		Upgrade/add facilities or amenities	Upgrade/improve some sites, realign some Developed sites	Decrease amenities
Elk/Bison Prairie/South Bison Range				
Turkey Bay OHV		Sustainable Day-use; upgrade camping outside	Sustainable, camping within	Sustainable; camping as is
EE facilities		Upgrade, expand: e.g. culture trails	Improvements possible	
Nature Watch Demo Area			Convert from EEA, add acres; S. No Hunt Area	Convert from EEA, add acres; S. No Hunt Area
Non-Facilities-Based EE			Increase	Increase
EE Area (EEA)		No EEA boundaries	Expand to Nature Watch	Expand to Nature Watch

Table 2.5B –Summary of Acres By Alternative And Prescription – Draft

Acreage Disclaimer: Prescription allocations were mapped for each alternative using GIS applications and existing coverages. Acreage discrepancies reflect a margin of error created by the digital representation of conceptually based alternatives. These acres have been rounded to give approximated acres for each prescription area. See appendix for a description of the prescription coverages.

	Alt. W	Alt. X	Alt. Y	Alt. Z
1. Natural Resources Stewardship				
1.A General Forest	**120800**	**108660**	**104240**	**110140**
Forested	(114700)	(103190)	(98940)	(105090)
Open Lands	(6100)	(5470)	(5300)	(5050)
1.B Core Areas	**35180**	**40780**	**41800**	**45560**
1.C Oak-Grassland Demonstration Areas	**0**	**8630**	**8630**	**0**
1.D Managed Wetlands	**160**	**160**	**160**	**160**
1.EWildlife Refuges and No Hunting Areas	**30**	**30**	**30**	**30**
2. Administrative Areas				
2.A Utility Corridors	**760**	**760**	**760**	**760**
2.B Infrastructure – Administration, Maintenance, Closed facilities*	**4560**	**4550**	**4550**	**4550**
2.C Designated Communication/Electronics Site	**9**	**9**	**9**	**9**
3. Recreation and Environmental Education				
3.A Developed Recreation Areas	**3810**	**4000**	**3780**	**3220**
3.B Turkey Bay	**2160**	**2160**	**2160**	**1700**
3.C Environmental Education Facilities	**3800****	**1530**	**1270**	**1200**
3.D Nature Watch Demonstration Area	**0**	**0**	**3890**	**3920**
Total Acres***	**171270**	**171270**	**171280**	**171250**

* Acreages for Roads and Road Right of Ways are included to account for land area associated with roads

** EE Facilities contain acreage of the Environmental Education Area (Prescription 3.E) in Alternative W

*** Acreages are rounded to the nearest 10's, therefore total acreage is different across alternatives

Chapter 3

AFFECTED ENVIRONMENT AND ENVIRONMENTAL CONSEQUENCES

3.0 Introduction

The purpose of Chapter Three is to present the wide range of resource characteristics, elements, and components that comprise LBL, which would be affected by the implementation of the different Alternatives. It explains the conditions of the environment, the resources and the features of LBL as they are now, and depicts some of the historic effects that have developed them to this point. It further draws upon scientific analysis, computer and mathematical modeling, and comparisons to other forests, areas, or habitats, to present the possible resulting environmental consequences of each of the Alternatives.

This chapter summarizes the physical, biological, social and economic resource elements based upon the best information currently available for analysis. Each part of this chapter addresses the elements, features or factors relative to the issues, the need for change, and its potential to impact other elements within LBL as well as the surrounding area. The information is presented in quantitative as well as qualitative information and data, depending upon the availability and accepted accuracy of the information. Detailed discussion and explanation of these Analyses tools is listed in Appendix B.

3.1 Physical Environment

The Physical Environment described in this section refers to the air, soils and water resources. These resources are affected in different ways by the management actions, recreation activities, and land allocations and designations proposed in each Alternative.

3.1.1 Air Resources

Affected Environment – Air Quality

In addition to protecting the air, land, and water resources under their jurisdiction from the impacts of air pollution produced outside of federal lands (Clean Air Act, 1990), statutes and regulations also require federal land managers to protect air, land, and water from the effects of air pollutants originating from within federal lands (Clean Air Act, 1990; Organic Act, 1977; Wilderness Act, 1997). Activities within LBL such as prescribed fire, road construction/maintenance, recreational use, and timber management all have an impact on the air quality of National Forest System land. The Forest Service must minimize the impact of management activities on natural resources, including the Forest's contribution to general air pollution. To fulfill this responsibility, LBL must understand the impacts of pollution originating on National Forest System land as well as the impacts of pollution from sources outside LBL.

LBL is located in an area of increasing population growth and the associated demand for electricity and transportation (SAMI, 2002). Lying near the industrial heart of the United States, the region within which LBL is located sees a high concentration of coal-fired electrical generating facilities, the leading sources of sulfur dioxide (SO_2) and nitrogen oxide (NO_x) emissions. This network of coal-fired electrical power plants includes the generally defined Ohio River valley as well as TVA sources. In Kentucky alone there are 18 operating coal-fired power plants (EPA, 1999), with several more recently permitted by the state. The Tennessee Valley Authority's coal-fired electric generating plant in Muhlenberg County, KY (northeast of LBL), located within 150 miles of LBL, is one of the largest point sources of NO_x and SO_2 emissions in the nation. Many large NO_x and SO_2 emitting point sources in the nation are also located within 150 miles of LBL; all are electric generating plants. In addition, large highways in the vicinity of LBL add additional NO_x and volatile organic compounds to the atmosphere.

Nitrogen oxides are an important contributor to the formation of ground-level ozone on hot sunny days. Ozone affects the human respiratory system as well as vegetation. From 2000 through 2002, ozone concentrations at one out of four state monitors located near LBL exceeded the new 8-hour ozone National Ambient Air Quality Standard (NAAQS) (reference Table 3.1.1A). The 8-hour NAAQS is exceeded if the 3-year average of the 4th highest 8-hour concentrations exceeds 0.085 parts per million (ppm).

Table 3.1.1A Fourth highest maximum 8-hour ozone values and the three year averages for sites within 50 km. of LBL; Data for 2000 – 2002

State	County	Monitor ID	2000	2001	2002	3-Year Average
KY	Christian	21047000-6442011	0.081	0.082	0.093	0.085
KY	Graves	21083000-3442011	0.080	0.073	0.092	0.082
KY	Livingston	21139000-3442011	0.078	0.084	0.090	0.084
KY	McCracken	21145102-4442011	0.084	0.077	0.086	0.082

- Units reported in parts per million (ppm). Values in red exceed the EPA standard of 0.085 ppm. Air quality sampling, analysis, and reporting is the result of joint effort of KY & TN air regulatory agencies and the EPA. Data summaries obtained from EPA - www.epa.gov/air/data/

The two largest sources of nitrogen oxides affecting LBL originate from electric generating plants (especially during hot summer days when electricity is needed to cool homes and businesses) and from highway vehicles. As current air laws, rules, and regulations are fully implemented, nitrogen oxide emissions are predicted to decrease over the Area Plan period. These reductions should lower the highest concentrations of ozone, resulting in lessened effects from ozone on vegetation growth in the coming years. Further reductions in nitrogen oxide are also anticipated as state and local air pollution control agencies seek ways to attain the new ozone standard in urban areas near LBL. Continued reduction of nitrogen oxide emissions will benefit the health of LBL visitors as well as vegetation.

Sulfur dioxide and NO_x emissions are transformed in the atmosphere into sulfates and nitrates (from sulfur dioxide and nitrogen oxides), which contribute to acid deposition and regional haze. Approximately 80 percent of the sulfur dioxide emissions affecting LBL are released from coal-fired power plants. Power plants within 100 kilometers of LBL most likely influence the acidity and sulfate concentration of rainfall on LBL. Monitoring data for western Kentucky suggests that LBL lies in an area of moderately high sulfate and nitrate deposition for the United States. This level of deposition can be detrimental to aquatic and soil resources in ecosystems not adequately buffered. Most of LBL's soils and geology have sufficient buffering capacity, and acidification is not evident. Aquatic ecosystems on LBL show no signs of acidification from atmospheric deposition, again due to adequate buffering. The same pollutants that cause acid deposition also affect visibility.

Regional haze and reduced visibility is caused primarily by sulfates emitted by coal-fired power plants. The estimated natural background visibility for the eastern United States is 93+/-28 miles (NAPAP, 1991). However, there has been a significant reduction in how far an observer can see into the distance as well as the clarity of that view. Visibility monitoring data from Mammoth Cave National Park provides the best estimate of haze conditions on LBL. The clearest days have the lowest fine particle mass (4.23 micrograms per cubic meter [ug/m3]), and estimated visibility is 57 miles (using the annual average relative humidity of 84 percent). On the highest mass (20.67 ug/m3) days visibility is reduced significantly to 14 miles. These days are most likely to occur from May through September (IMPROVE, 2002), a time of high visitation by the public. Secondary fine particles, fine particulate matter less than 2.5 microns in diameter ($PM_{2.5}$), are primarily responsible for visibility impairment, with sulfates the most significant of these fine particles. On low mass days sulfates comprise 48 percent of the total mass, while on the highest mass days, sulfates comprise 70 percent of the total (IMPROVE, 2002). Sulfur dioxide is expected to decrease in the vicinity of LBL within the Area Plan period as nearby electric utilities, especially the Tennessee Valley Authority, continue to install best available control technologies.

The fine particles that cause visibility impairment also can be unhealthy for people, high concentrations aggravate respiratory conditions such as asthma. Fine particles are closely associated with increased hospital admissions and emergency room visits for heart and lung disease, increased respiratory disease and symptoms, decreased lung function, and even premature death (EPA, 1997). Vulnerable groups at greater risk include the elderly, individuals with cardiopulmonary diseases such as asthma, and children. This makes monitoring of fine particle levels important.

Monitoring results for fine particulates include both fine primary particulate (emitted directly from a source) and secondary particulate (resulting from the transformation of gases in the atmosphere). The US Environmental Protection Agency has established NAAQS for fine particles ($PM_{2.5)}$ based on three-year averages of the monitoring data. The $PM_{2.5}$ annual average standard is 15 micrograms per cubic meter (ug/m3). Table 3.1.1B lists results from monitors near LBL from 1999 through 2001. Results indicate that the annual average $PM_{2.5}$ standard may have been exceeded at the Christian, McCracken, and Montgomery County monitors. The $PM_{2.5}$ short-term (24-hour) standard is 65 ug/m^3 based on a 3-year average of the annual 98th percentile values. (Note that the short-term concentrations are maximum values, not the 98^{th} percentile). The 24-hour average NAAQS does not appear likely to be exceeded when the data from the closest monitoring sites to LBL are averaged for three years.

Table 3.1.1B Fine Particulate annual average and 24 hour max values for monitors within 50 km. of LBL. Values for sites in red exceed the NAAQS

State	County	Monitor ID	1999		2000		2001s	
			Annual Avg	24 Hr Max	Annual Avg	24 Hr Max	Annual Avg	24 Hr Max
KY	Christian	21047000-6881011	15.34	35.0	17.03	40.4	14.51	33.4
KY	McCracken	21145100-4881011	15.8	39.7	15.31	40.8	14.62	33.0
TN	Montgomery	47125100-9881011	16.74	43.0	15.33	33.4	13.93	27.5

* Air quality sampling, analysis and reporting are the result of joint effort of State air regulatory agencies and the EPA. Data summaries obtained from EPA - http://www.epa.gov/air/data/index.html

Based on the 1999-2001 ozone and fine particulate state monitoring data, the Clarksville-Hopkinsville metropolitan statistical area (Christian and Montgomery County monitors) could be designated non-attainment for ozone. It is expected that no counties within the immediate vicinity of LBL will be designated non-attainment for fine particulates, although the Owensboro metropolitan area (Daviess County, lying northeast of LBL) could be designated as non-attainment. Ultimately, the states and EPA will make non-attainment determinations for fine particles and ozone based on monitoring data that incorporates 2002 and 2003. Minimizing prescribed fire emissions to the greatest extent practical during days characterized by existing or predicted high ambient air pollution, therefore, becomes important for prescribed fire managers. The $PM_{2.5}$ standard may require even more vigilance in smoke management to protect citizens on and off National Forest System lands from the effects of particulate emissions associated with prescribed fire.

Once an area is cited for non-attainment, a State Implementation Plan (SIP) is developed in an attempt to bring the area back into attainment. This usually involves placing controls on various sources that contribute to the pollutant of concern. Current emission inventories do not accurately reflect emissions from prescribed burning. Since 70 percent of particulate emissions from prescribed fires are fine particles, nitrogen oxides and volatile organic compounds are also released, therefore, state air regulators may be concerned. LBL will need to interact closely with the KY and TN air regulatory agencies and the VISTAS Regional Haze Planning Organization to ensure that LBL prescribed fire emissions (and perhaps other management activities) are accurately considered in SIP's for visibility, and perhaps for ozone and fine particulates as well.

Environmental Effects of Prescribed Fire

As an ecological process, prescribed fire is essential in creating and maintaining functional ecosystems and achieving other land use objectives. However, emissions from prescribed fire, as well as from wildland fire, affect air quality. In 1997, the Environmental Protection Agency (EPA) adopted more stringent air quality standards for ozone and $PM_{2.5}$ to protect human health (EPA, 1997). One challenge in using prescribed fire is balancing the public interest objectives of protecting human health and welfare (from air pollution) with sustaining ecological integrity. Recognizing this, the EPA developed an interim air quality policy for wildland and prescribed fires that allows fire to function, as nearly as possible, in its natural role of maintaining healthy ecosystems, but still protects public health and welfare by mitigating the impacts of emissions on air quality and visibility (EPA, 1998).

To minimize the negative effects of smoke and associated pollutants on visibility and human health, smoke management plans are a required part of every prescribed fire. The smoke management plan identifies smoke dispersion characteristics that must be met in the weather forecast for the day of the burn. These characteristics include: depth of the atmosphere available for smoke mixing (dispersion), transport wind speed and direction, and probability of air mass stagnation during the day. LBL also identifies smoke sensitive targets (including non-attainment areas) within the probable smoke impact area and coordinates with them to avoid or mitigate problems. Actual weather conditions and smoke behavior are monitored to make sure they meet the plan. By planning and executing prescribed fires on days that maximize smoke dispersion and avoiding smoke sensitive areas, the negative effects of smoke can be minimized.

Several Area Plan alternatives propose substantial increases in the use of prescribed fire over current levels. At the same time, some counties within or near LBL proclamation boundary could exceed the NAAQS for ozone and be found in non-attainment. Non-attainment for the fine particulate standard is not expected to be an issue within or near LBL within the Area Plan period. The primary prescribed fire pollutant of concern to state air regulators, and the Forest Service, are fine particulates ($PM_{2.5}$). By mass, the largest NAAQS pollutant emitted from prescribed fires are fine particulates ($PM_{2.5}$), NOx emissions (a primary component of ozone production) are a relatively minor component of prescribed fire smoke. Information sharing and other cooperation between the Forest Service, state air regulatory agencies (Tennessee and Kentucky), and others will be essential to incorporate Forest Service emissions into the inventories needed to develop future attainment plans. LBL will also be expected to follow “conformity” (applicable to non-attainment areas) rules and report any prescribed fire emissions for activities planned in non-attainment areas.

Effects Common to All Alternatives

Direct and Indirect Effects

Emissions from both prescribed and wildland fires are generated by incomplete combustion and include particulate matter, carbon monoxide, carbon dioxide, nitrogen oxides, and hydrocarbons (Hardy, et al. 2001). The single-most important emission is fine particulate matter less than 2.5 microns in diameter ($PM_{2.5}$), which limits visibility and aggravates respiratory conditions in susceptible individuals. Fine particulates ($PM_{2.5}$) make up more than 70 percent of the mass of particulate matter produced by fire, therefore, $PM_{2.5}$ emissions were used to compare the direct effects of alternatives on air quality. Emission estimates are calculated for the maximum acres planned for treatment using estimates of fuel type, amount of fuel consumed, and emission rates for the types of burns planned. The results are presented in Table 3.1.1.C below. Actual acres burned in any given year, as well as resulting $PM_{2.5}$ emissions, will depend on weather conditions and other factors that must be considered prior to initiating a prescribed fire.

Emissions from prescribed fire are only one of many sources of $PM_{2.5}$ pollution. Other sources of fine particulates include power plants, industries, and vehicles. For the effects analysis, forest-wide $PM_{2.5}$ emissions are estimated for each alternative and compared to current "primary" $PM_{2.5}$ emissions (not included are "secondary" $PM_{2.5}$ emissions produced as a result of atmospheric chemistry – much harder to quantify) from other sources. The analysis area is comprised of counties containing National Forest System lands. This analysis assumed that no other regular prescribed fire program is conducted on private lands within the three counties of LBL.

In order to compare prescribed fire emissions to total emissions in the analysis area, the most recent EPA emissions inventory (1999) was used. It estimates primary $PM_{2.5}$ emissions at 2,227 tons per year (EPA 1999). It is important to remember that fine particulates can be emitted directly into the atmosphere or they can be created from gaseous pollutants that are chemically transformed into particulates (secondary pollutants). Only those particulates emitted directly into the atmosphere (primary pollutants) are tracked in emission inventories; secondary particulates are not included. Because a large amount of $PM_{2.5}$ is secondary pollution, the contribution of prescribed fire emissions to total $PM_{2.5}$ would be significantly less than what is shown in this analysis.

Predicted changes in emissions are based on a regional assessment and are not representative of any one particular location on LBL. The estimated emissions, shown in Table 3.1.1C, would not be evenly distributed across LBL because treatment areas will vary annually. Site-specific analyses of smoke dispersion and downwind fine particulate impacts occur when sites are selected for treatment.

Table 3.1.1C Estimated particulate matter ($PM_{2.5}$) emissions, in tons, resulting from prescribed fires on LBL.

	Forested Acreage	Prairie Acreage	Forest Emissions	Prairie Emissions	Total Emissions
Background 1^0 $PM_{2.5}$ Emissions*	NA	NA	NA	NA	2,227
Alternative W	0	910	0	13	13
Alternatives X/Y	9,658	1,230	1,226	18	1,244
Alternative Z	4,346	1,183	551	17	568

* - From EPA's "National Emissions Inventory" (1999); compilation of "area" and "point" emissions for analysis area counties (Lyon, KY, Trigg, KY, and Stewart, TN). http://www.epa.gov/air/data/reports
Emissions estimation tool - "First Order Fire Effects Model" (FOFEM), version 5.0. FOFEM is a product of the Forest Service's Rocky Mountain Research Station, Missoula Fire Laboratory (http://fire.org)

Alternative W

Direct and Indirect Effects

Alternative W represents a continuation of the current prescribed fire program of LBL. Currently LBL practices prescribed fire treatments in campgrounds, prairies, and open field areas. Prescribed fire would be practiced on a maximum of 910 acres in these areas annually, producing approximately 13 tons of $PM_{2.5}$ per year. The effects analysis that follows compares emissions from alternatives to the average emissions from actual prescribed fire programs over the past 10 years (approximately 900 acres per year).

Cumulative Effects

Emissions from Alternative W represent approximately 0.6 percent of primary $PM_{2.5}$ emissions in the analysis area.

Alternatives X and Y

Direct and Indirect Effects

Since the number of acres proposed for treatment in Alternatives X and Y are the same, emissions would be the same. These alternatives propose prescribed fire on 10,835 acres annually (forest lands = 9,658 acres; prairies = 1,230 acres), producing approximately 1,244 tons per year of fine particulates. Alternatives X and Y would incrementally increase the acres treated over the planning period from approximately 900 acres today to 10,835 acres. Prescribed fire programs in Alternatives X and Y would produce the highest levels of $PM_{2.5}$ of all alternatives. Acres treated under Alternatives X and Y would significantly increase fine particulate emissions when compared to Alternative W.

Cumulative Effects

Emissions from Alternative X and Y would increase primary $PM_{2.5}$ emissions in the analysis area approximately 55 percent on an annual basis. Emissions from Alternative X and Y represent approximately 56 percent of primary $PM_{2.5}$ emissions in the analysis area.

Alternative Z

Direct Effects

Alternative Z represents about half the prescribed fire program as Alternatives X or Y, consequently emissions would be approximately half of Alternative X or Y as well. Alternative Z would incrementally increase the acres treated over the planning period from approximately 900 acres today to 5,529 acres (forest lands = 4,346 acres; prairies = 1,183 acres). The estimated acreage of prairies to receive prescribed fire treatments is comparable in Alternatives W, X, and Y. Alternative Z fine particulate emissions are significantly greater than Alternative W but approximately one half of those of Alternatives X and Y.

Cumulative Effects

Emissions from Alternative Z represent approximately 26 percent of primary $PM_{2.5}$ emissions in the analysis area.

3.1.2 Geology and Soils

Geology

LBL lies along the eastern edge of the ancient Mississippian Embayment, within the Ohio River basin of the central United States. Its current physiography results from impoundments of the Tennessee and Cumberland Rivers, the dominating physical elements of LBL. The rivers form topographic trenches roughly parallel to each other along the length of LBL. Topography is greatly dissected by numerous tributaries of each river that head against each other so as to form a narrow drainage divide. The divide between the rivers is somewhat closer to the Tennessee than to the Cumberland, and the elevation of the divide is relatively even. Original maximum relief before the lakes were formed was just under 100 yards. The present lake elevation reduces this relief somewhat. Tributaries and their dissections are so close together that most of the area occur on sloping hillsides. They have steep gradients in the headwaters but their lower courses have low gradients with broader valley floors. Confluences of the tributaries with the major rivers are nearly at right angles, exhibiting a landscape controlled by geologic structures such as faults and bedrock strike. LBL's mature topographic features are displayed in its narrow ridge crests, steep slopes of low relief, sediment-filled valleys and channels, and narrow bottomlands.

Bedrock is predominantly cherty limestone of the Mississippian System and part of the stable North American continental plate or craton. LBL owes its homogeneity of bedrock and topography to the fact that the rivers parallel the strike of the bedrock throughout the entire length of LBL. Limestone is a soluble rock while chert is resistant both to solution and abrasion. Some lithologic units contain thin shale layers and disseminated clay and silt, which together with the chert form the residual weathered product. Weathering of pure limestone would form no soil. Surface exposures of bedrock are uncommon in LBL, occurring primarily along lakeshores.

Chert is an abundant constituent of the limestone bedrock. Rock fragments of chert are a major residual product of weathering of the soluble limestone. Angular chert fragments of all sizes are present in the soil profile and loose on many hillslopes. Chert reaches waterways by mass wasting or direct scouring of stream channels.

Glaciers did not reach the Tennessee or Cumberland valleys so there are no glacial deposits in LBL. Indirect effects of glaciation just to the north of the LBL region are evident by: deepening of the valleys; ponding and aggradation of the valleys; and deposition of windblown silty and sandy loess mantling uplands. Caves and caverns are unknown and sinkholes are uncommon within LBL compared to the Pennyrile region just to the east. This may be indicative of much less water circulating underground than places east. Another postulation is there may have been insufficient geologic uplift to expose caverns above the deeper water-filled cavities.

LBL is situated just east of the New Madrid Seismic Zone, the region affected by the Reelfoot Rift System. This was the location of high intensity earthquakes in 1811 and 1812. LBL is outside the zones of major activity though it would be within the area of potential damage. This region is the junction of several major structural elements of east-central United States. The triple junction of the rift controls the location of the lower Tennessee River.

Soils

Affected Environment

Soil is the part of the earth's surface composed of organic matter, minerals, and living organisms, and is capable of supporting a wide variety of biological, chemical and physical processes, and the cycling of nutrients and water. Soil is the result of weathering of parent rock material over extended periods of time influenced by climate and living matter, conditioned by relief, and effected by both natural events and the cultural alterations or uses of human beings. A soil's physical materials consist of sand, silt, clay, and organic matter. Other particle sizes such as gravel, cobbles and boulders may be included with the soil mixture as a result of past geologic, geomorphic, and hydrologic movements. These materials can be found in various combinations, depths of internal soil features, and development type from residual materials, erosion, or deposition, to form a soil series. Geology, climate, moisture, wind, and hydrologic regimes can have an influence on soil development.

The USDA Natural Resource Conservation Service (NRCS), formerly Soil Conservation Service (SCS), last completed county soil surveys for Kentucky's Trigg and Lyon Counties in 1981 and Tennessee's Stewart County in 1953. The following soils information was taken from USDA Soil Conservation Service (1981) for Kentucky soils and USDA Soil Conservation Service (1953) for Tennessee soils in LBL. The information contained in the 1953 Soil Survey of Stewart County, Tennessee will be used during this planning process; however, an updated soil survey for the Stewart County portion of LBL is scheduled to begin fiscal year 2003. This updated version will be used during the plan implementation stage.

According to current GIS data, the Lyon and Trigg County portion of LBL consists of approximately 17 soil series and 33 soil mapping units. The Stewart County portion of LBL consists of approximately 35 soil series and 83 soil mapping units. Each map unit on a soils map is a unique natural landscape. Typically, a soil map unit consists of one or more major soils and some minor soils. Soil series consists of soils that have similar horizons in their profile. The horizons are similar in color, texture, structure, reaction, consistence, mineral and chemical composition, and arrangement in the profile. Refer to Appendix E for a list of the soil mapping units of LBL.

Generally, most of LBL soils are derived from limestone or gravelly coastal plain residuum, or from Pleistocene loess in combination with one of these substrates. Many of the soils derived from underlying parent material are typically low in nutrients. Due to the dissected nature of the topography, erosion over a long period of time had a major impact on the processes of soil formation on the ridge tops and upland slopes. The most common upland soils are of six types: Baxter, Bodine, Brandon, Hammack, Lax, and Saffell. In LBL, soils are so closely interspersed that they are most often mapped as soil complexes or combinations. Upland soils are mostly forested. About half the 12,550 acres maintained as open lands occurs in valley bottoms in long, narrow fields. Bottomland soils at LBL typically have high site indexes and are generally one of five types: Clifty, Ennis, Humphreys, Lindside, and Nolin.

The following is a list of the soil types of the upland areas of LBL.

Baxter-Hammack Soil Complexes: These soils are deep, steep to sloping, and well drained, with Baxter dominant on steep side slopes and Hammack on narrow ridge tops and moderate side slopes. Baxter-Hammack is commonly located on slopes from 20 to 30 percent where it is moderately subject to erosion but can occur on slopes of up to 60 percent creating a severe erosion hazard. Baxter soils have a brown cherty silt loam surface layer and moderately permeable subsoil that is predominantly clayey and cherty.

Hammack soils are formed in loess and do not have gravels. Hammack soils have a brown silt loam surface layer. The moderately permeable subsoil is loamy in the upper part and dominantly clayey and cherty in the lower part. As a soil complex, they are fairly productive for forest species (site index for oak in approximately 80).

Bodine soils: Bodine soils are classified only in Tennessee but occur under other classifications in Kentucky. Bodine soils occur on upper ridge slopes at the heads of small drains and on broader ridge ends with slopes of 12 to 25 percent. They are derived from cherty limestone or limestone residuum with rapid internal and surface drainage. They are often severely eroded, low in organic matter content, strongly to extremely acid in reaction, and have a site index for oak of 50 or less. Bodine soils are frequently associated with Baxter soils.

Brandon Silt Loams: These soils occur on slopes of six to 20 percent, and are deep and well-drained. Brandon soils are low in organic matter, strongly to very strongly acid in reaction, and moderately subject to erosion. Brandon soils have a brown silt loam surface layer and loamy, moderately permeable subsoil underlain by gravelly, loamy, and moderately rapidly permeable to rapidly permeable material. These soils can occur on north and south slopes. Site index for oak on Brandon silt loams ranges from 60 to 66. Brandon soils, like Hammack soils, are formed in loess and do not have gravels.

Lax Soils: Lax soils are deep, moderately well drained, and found on ridge tops and upper slopes of two to 12 percent. Lax soils have a brown silt loam surface layer except in severely eroded areas where it is silty clay loam. The upper part of the subsoil is loamy and moderately permeable. Because of their formation in loess and gravelly coastal plain material, these soils have a fragipan which retards internal drainage. Lax soils have a slight erosion hazard rating and a site index of about 70 for oak.

Saffell Soils: These soils are associated with slopes of 20 to 50 percent. Saffell soils have a dark grayish brown and yellowish brown gravelly silt loam surface layer and a reddish brown, loamy, gravelly to very gravelly, moderately permeable subsoil. They are low in organic matter and strongly acid in reaction with a site index for oak of 50 or less. Saffell soils tend to be very gravelly with rounded chert fragments throughout all horizons.

About half the 10,650 acres maintained as open lands occurs in valley bottoms in long, narrow fields. Bottomland soils at LBL typically have high site indexes and are generally one of five types: Clifty, Ennis, Humphreys, Lindside, and Nolin.

Clifty Gravelly Silt Loams: These soils are deep, well drained, and nearly level. They are most often found near heads of branch bottoms and creeks. Typically, the surface layer is brown gravelly silt loam about six inches thick. The subsoil, extending to a depth of 34 inches, is brown gravelly silt loam. Permeability is moderately rapid with crop yields occasionally reduced by drought. Clifty soils are also occasionally subject to flooding. High gravel content makes tillage somewhat difficult. Clifty soils are medium to strongly acidic in reaction, moderate in organic matter content, and medium in natural fertility. Although some of these soils are cultivated in LBL, much remains in forest. Erosion hazard for Clifty soils is slight.

Ennis Cherty and Ennis Fine Sandy Loams: Ennis cherty loams (on three percent slopes) are well-drained cherty soils occurring on small areas generally in long, narrow bottoms underlain by cherty limestone. Ennis fine sandy loams (slopes up to three percent) occur in small-to medium-sized creek bottoms. A tendency to "dry out" low nutrient content, and high acidity dictate special methods for satisfactory crop yields.

Humphreys Very Fine Sandy Loams: These soils (on slopes of two to five percent) occupy low terraces in nearly all northern creek valleys and are well drained at the surface and internally.

Lindside Silt Loams: These soils are deep, moderately well drained, and nearly level. They are high in natural fertility, moderate in organic matter content, and range from medium acid to mildly alkaline in reaction. Typically, the surface is brown silt loam seven inches thick and subsoil to a depth of 18 inches is brown silt loam. Lindside soils are subject to periodic flooding, though rarely during the growing season, and are well suited to cultivation and woodland uses. Their erosion hazard rating is slight.

Nolin Silt Loams: Nolin silt loams occur on floodplains and in depressions on uplands, primarily near larger streams. They are deep, well drained, and nearly level. Typically, the surface layer is brown silt loam about 10 inches thick. They are mildly alkaline to medium acid in reaction, moderately permeable, high in natural fertility, and moderate in organic matter content. Nolin soils are subject to late winter and spring flooding, which rarely affect crop yields. Erosion hazard for Nolin soils is slight. Most Nolin soils in LBL are cultivated.

Direct and Indirect Effects

Soil Productivity

Soil productivity is defined as the capacity of soil, in its normal environment, to support plant growth. Soil productivity is reflected in the growth of forest vegetation or the volume of organic matter produced on site. In forest management, soil productivity is most often measured in volume of trees produced; however, other methods of determining productivity exist including forest community assessments.

In forest planning there are various laws, executive orders, regulations, and policy set forth in the Forest Service Manual that address productivity. Section 6 (3)(E)(i) of the National Forest Management Act (NFMA) of 1976 "insures that timber will be harvested from National Forest System lands only where soil, slope, or other watershed conditions will not be irreversibly damaged." Accordingly, section 36 CFR 219.14 (a)(2) of the National Forest Management Regulations limits timber production on National Forest System lands where conditions may contribute to irreversible damage to soil productivity or watershed conditions. Section 36 CFR 219.27 (a) (1) and (b)(5) addresses the conservation of the soil and water resources and not allowing significant impairment to land or site productivity when managing National Forest System lands.

On most forests, soil productivity is one of the primary concerns. Conditions that can influence soil productivity include soil type, aspect, erosion potential, nutrient composition, and past land use. Soil productivity can be reduced by overgrazing, severe wild land forest fires, mining activity and other natural and anthropogenic activities. Highly erodible soils characterized by having little to no organic or mineral surface horizon, deficient of nutrients, limited vegetation cover, and commonly located on slopes greater than 10 percent are generally found on unproductive sites. Intense forest management activities and other land use on highly erodible soils can contribute to soil erosion and sedimentation which decreases soil productivity and water quality.

Effects to Soil Productivity from Forest Service actions

Direct Effects

- Compaction
- Land Use Change
- Soil Displacement (Topsoil Removal)
- Soil Improvement

Indirect Effects

- Erosion/Soil Movement
- Vegetation Removal/Nutrient Cycling
- Prescribed Fire Use

Soil Compaction

Soil compaction is the increase in soil density resulting from loads applied to the soil surface. During the compaction process, soil volume is decreased primarily through the elimination of macro-pores (pores > 0.002 inches in diameter). Soil compaction is one of several types of closely related physical soil disturbances that can occur during timber harvesting and forest management activities. Other types of soil physical disturbance include puddling, rutting, and scarification. These disturbances often occur simultaneously and are almost exclusively caused by:

- Heavy equipment trafficking during felling, forwarding, skidding and site preparation operations;
- The dragging action of logs as they are moved from the stump to the landing;
- Slash disposal and the creation of planting or seeding sites during site preparation.
- Recreational uses such as OHV and equestrian trails.

Land Use Change

If a soil on LBL has the ability to produce biomass, it then has productivity. If this same soil, for example, is converted to a parking lot, building site, paved road, or into some other use that prevents it from producing biomass, then it has lost some or all of its productivity for some time, probably a long time (> 100 years). Land use change is considered a long-term impact to soil productivity.

Soil Displacement (Topsoil Removal)

Soil displacement is the horizontal and vertical movement of surface soil from its original position on the landscape. The surface horizon or topsoil can be moved from one place to another through mechanical means (e.g., skidding of logs, blade construction of skid roads, landings, temporary and system roads, OHVs, etc.). Since the surface horizon makes up the organic and mineral soil layers, soil displacement contributes to a loss in soil productivity which affects the growth of plants. Soil displacement associated with soil compaction may alter soil texture, and physical, chemical, and biological characteristics, which can lead to accelerated erosion, surface run off, and stream sedimentation.

Commonly, soils displacement occurs as a result of heavy equipment on saturated soils in lowland areas and on upland soils containing steep slopes. Heavy equipment on saturated soils can cause soil puddling. Puddled soils create a poor medium for plant growth because aeration is restricted, pore structure is reduced, and the retention of water is increased. Droughty conditions may cause puddled soils to crack on the surface which reduces root penetration and impacts plant growth and establishment.

Soil Improvement

Maintaining soil productivity is important to assure adequate forage and timber. Bottomland areas, especially wetland and riparian areas, with high flood potential are susceptible to soil compaction and rutting. Soil compaction and rutting directly impacts soil productivity because it reduces aeration, significantly decreasing plant root respiration and the capacity to supply the plant adequate moisture and nutrients. An inventory of watershed improvement needs for those areas needing rehabilitation, stabilization, and full restoration will need to be updated in the Watershed Improvement Needs Inventory (WIN) database and/or National Resource Inventory System (NRIS). This inventory of low productivity (nutrient deficient) and eroding lands includes areas such as gullies, quarries (borrow pits), galls, barren areas of soil, and other similar areas void of vegetation (such as trails and roads that have been closed and are no longer on the system).

Continuous monitoring of these areas for quality control will give the effectiveness of treatments and practices used and will aid in future project implementation plans. Areas needing soil and water improvements that are found through project reconnaissance and land exchange or acquisitions will be assessed and updated in the WIN and/or NRIS databases as needed. The purpose of soil and water improvements is to address existing problems that are not a direct result of past or ongoing forest management activities.

Each state's Best Management Practices (BMPs) are established as practical guidelines to be used to reduce the environmental impact of forest management activities. The Region 8 Soil and Water Conservation Practices Guide (SWCP) includes all the measures that are needed to address the direction to protect soil and water resources. The use of this guide will help to avoid or minimize significant adverse impacts of management activities on soil and water resources and beneficial water uses. Also, this guide will be used to mitigate effects to the soil and water resources and to assure that water resources meet the intent of the Clean Water Act. This guide is in compliance with a variety of legal and environmental direction including the Clean Water Act, Coastal Zone Management Act, Floodplain, Wetland, and other Executive Orders, State BMPs, State Forest Practices and Water Quality Regulations, Forest Plans, R8 Vegetation Management Plans, and US Forest Service Directives, Manuals and Handbooks.

Erosion (Soil Movement)

Soil erosion is another type of physical soil impact that can occur as a result of soil disturbance during timber harvesting, site preparation, and other forest management activities. Soil erosion is the process by which soil particles are detached and transported by water, wind or gravity to some down-slope or downstream point. Erosion is a natural process. Soil erosion can be accelerated as a result of impacts by humans. Soil erosion is a major concern on most forests but with the use and careful design of BMPs and R8 SWCP Guide, erosion and sedimentation will be reduced significantly.

LBL has a moderately dissected topography with narrow ridge crests, steep slopes, and narrow bottomlands. This landscape has been formed by erosion caused by surface water run off. The density of steep valleys is due to the proximity of the Tennessee and Cumberland River valleys and the relatively moderate topographic relief between the river channels and LBL's uplands. In addition to the processes associated with surface water, climate and weathering, mass wasting, and groundwater have helped shape the land.

Vegetation Removal (Nutrient Cycling)

When vegetation is removed from a site, a portion of the potential organic matter and its available nutrients to the soil is removed with it. The resulting condition of a reduced canopy (shade) can have an effect on soil temperature, soil moisture, and nutrient cycling. This situation will normally occur with a timber harvest. The bole of the tree is removed from the site and the forest canopy opens up to allow more sunlight and moisture to reach the soil surface. Other parts of the tree will remain on site to recycle into the soil system over time. Loss of trees will reduce evapotranspiration and increase soil moisture. Loss of canopy will increase soil moisture and temperature in the topsoil. These conditions will increase soil organic matter decomposition and increase available nutrients on the treated area. Much of this increase in plant available nutrients will be taken up by the stump sprouting of hardwood trees and the root systems of the remaining vegetation on the treated area. Some nutrients may be leached from the site and reach local streams. The leaching effect is short-term and literature has shown that removal of the tree main stem alone will not reduce long-term soil productivity. These short-term losses are made up by leaf fall, atmospheric additions, and weathering of parent material. Any increased leaching of nutrients from the soil would be very short term (< five years).

The resource management areas at LBL that could have an effect on the soil resource are Forest Management, Open Land Management, Recreation Management, Roads and

Trails, and Fire Management. Management activities within these areas may affect soil productivity through a variety of processes including: soil compaction; land use change; displacement; soil improvement; erosion (soil movement); and vegetation removal (nutrient cycling). These processes are capable of altering the physical, chemical, and biological functions of the soil.

Forest Management

Forest management activities that affect soil and water are timber harvesting, site preparation, timber stand improvement projects, skid trail construction, and felling, yarding, skidding, loading, and transporting logs. Most of these effects are temporary, lasting only a few years. Loss of the protective soil cover (litter) from ground disturbance can increase erosion and sedimentation while decreasing soil productivity. Various aspects of forest management can influence soil, water, and riparian conditions as summarized in various sections of the R8 Vegetation Management Plan. Activities under this section include many actions that are needed to maintain, manage, or manipulate vegetation densities and types to improve forest health and wildlife habitats.

Effects of Forest Management by Alternative

Within the General Forest Prescription, timber removal will only occur for forest health reasons, wildlife habitat improvement needs, ecological restoration purposes, and to enhance visual quality. Some scheduled silvicultural treatments and/or prescribed fire would be used as a tool to reach the desired condition of this prescription. Alternatives X and Y emphasize two Oak-Grassland Restoration Demonstration Areas in which thinning and prescribed fire would be used to reach the desired condition of these areas. The location of these demonstration areas on the landscape would be on upper slopes and ridges where the soils are generally erodible and infertile.

There has been no timber harvesting since the management transition from TVA to the Forest Service in 1999. Although no logging has occurred to date by the Forest Service, Alternative W does allow for timber harvesting. Areas needing soil and water improvements as a result of past timber harvesting activities will be assessed and inventoried at the project level for implementation. The impact on soil productivity across LBL is small in Alternative W. Alternatives X and Y would have more impact on soil productivity than Alternatives W and Z since thinning and prescribed fire will be used to reach the desired condition for the Oak-Grassland Restoration Demonstration Area. Adhering to regional guidance such as the R8 SWCP Guide and utilizing Kentucky and Tennessee State BMPs in an effective and timely matter will minimize impacts on soil productivity and water quality over the short and long term.

Open Land Management

Five categories of open lands including cooperative farming, woods openings, wildlife food plantings, other (reverting) open lands and miscellaneous lands are being managed at LBL. Currently there is a total of 10,650 acres of open lands on LBL. Table 3.2.5A under the Biological Elements section includes acres of grassland cover/structure type and non-grassland cover/structure type located on the major site types in LBL. There are 6,522 acres of the grassland cover/structure type and 4,124 acres of non-grassland cover/structure type.

These areas are being managed for a variety of reasons requiring specific management practices for each area. Management practices applied to each category of open lands are capable of affecting soil productivity through soil compaction, erosion and sedimentation, displacement, fertilization and fire.

A variety of treatments are used to manipulate vegetation to meet specific wildlife and biotic viability, habitat, public hunting, or observation activities. Maintenance activities regularly include mowing and infrequent burning when contained within prescribed fire treatments or low frequency disking.

Most of these areas include some form of road or trail access and are located on relatively flat lands under eight percent slope where erosion is relatively low. Constructing sites from forest areas may include activities such as clear cutting, stumping roots, piling debris, smoothing, disking, fertilizing, seeding with desired and/or native species, and mulching.

Problem access roads or routes would be upgraded as needed to limit erosion and sediment effects. Maintained open lands are assumed not to be disked frequently enough to be classified as cropland or wildlife plantings, but are best classified as grasslands. Hayfields are open lands dominated by grasses and herbs that are annually mowed for hay under a cooperative hay farming program. Old fields are open lands dominated by grasses and herbs, but which do not meet the definition of native grasslands and are not regularly hayed. They may be maintained by mowing on a relatively long cycle (> two years) or be succeeding to forest and would include shrub growth species. Road right-of-ways (ROW) are open land areas maintained annually by mowing along major roads while utility ROWs are open land areas maintained for clearance under and over power-lines and gas-lines.

Effects by Alternative for Open Lands

Wildlife plantings are open land areas maintained and planted solely for the benefit of wildlife. These are generally smaller than cropland patches and are maintained by Forest Service or state agency staff. These areas are planted typically in corn or a mixture of milo/iron-clay cowpeas/Korean lespedeza or other desirable forb/legume species. Plantings result in wildlife foods available through summer, fall, and winter. Regular treatment with fertilizer, or selection of nitrogen-fixing plants in the seed mixture, helps to maintain productivity. Increased use of native plants is encouraged and may result in less intense maintenance and maintenance of soil cover and roots. Once developed, native grasses are more resilient, require less maintenance, and can withstand more or are not as susceptible to disturbance (such as fire, drought, insect, disease or poor sites) than most non-native species. Native grasses also have dense root networks that help to increase soil development, organic content, and productivity.

The woods openings are managed to provide green forage for wildlife habitat diversity and distribution. Most tracts are currently located where no cooperative farming occurs or in highly visible areas. They are located in interior forested areas, adjacent to roadsides, and in other areas not suitable for cooperative farming. These openings are disked and seeded in early fall to a combination of winter wheat, cool season grasses, and legumes. The areas can be mowed during the following years to maintain the grass/legume forage. The areas planted are rotated for management about every three years to the point that succession advances to the grass/legume or forb stage.

Under Alternatives X and Y there would not be a net increase in open lands but only reallocations and/or restorations. Currently, in Alternative W, there are 1,557 acres of wildlife plantings/woods openings. The current acres under Alternative W would reduce since Alternatives X, Y, and Z would implement much larger riparian corridors while focusing more on native grass restoration. According to Table 2.5 (Alternatives Comparison Matrix by Issue), 700 acres of interior open lands would revert to general forested acres under Alternative Z. Areas converted to woodland and savanna management may include some short-term increase in base-flow, erosion and sediment, and long-term site productivity. Areas burned with moderate intensity will affect soil productivity if on steep slopes. Areas burned with severe intensity will influence soil productivity on all but relatively flat slopes. There is currently a total of 1,811 acres of cultivated cover types located on riparian site types. These acres located in close proximity to streams would be reallocated throughout alternatives. A further discussion on effects can be found under the Watershed section of this FEIS.

Erosion reduction measures include using contour, no- or low-till, and leave-strip treatments. Fertilization, seeding, mulching, and other erosion control measures are necessary in order to maintain soil cover and nutrients and to limit erosion and sediment, especially on sites with slopes over three percent slope that are repeatedly treated.

Adhering to the requirements of forest standards and guidelines and the application of Kentucky and Tennessee BMPs and/or R8 SWCP Guide will minimize the impacts on soil productivity and reduce soil erosion with effective and timely implementation.

Recreation Management

LBL, unlike other forests in Region 8, is a National Recreation Area. The primary purpose for the establishment of LBL is for Rec/EE use and development. Therefore, there are various activities associated with recreation management at LBL that have an effect on the soil and water resources and soil productivity. Such recreational activities include horseback riding, hiking and biking trails, camping, site conversions (facility development), and off-highway vehicle riding. These recreational activities are capable of altering soil productivity through soil compaction, erosion, and displacement.

Developed and concentrated use sites expose and compact soils, alter surface and subsurface water flow patterns, and can alter stream channels during and following construction. These activities can increase erosion, sedimentation, and run off. Occasionally OHVs, horses, and other users do not stay on designated trails. User-created trails cause increases in soil exposure, compaction, displacement, erosion, sedimentation, and productivity loss. Reclamation of these impacts is costly and detracts from other management activities.

Riparian and stream areas are often a desired focal point of many recreational activities. People love the sights, sounds, life, and movement associated with streams and riparian habitats. However, riparian areas and streams are often very sensitive, from a physical and biological standpoint, to many activities that people enjoy. Activities involving concentrated people or animal uses, motorized & non-motorized activities, generally create problems in riparian areas because compaction or entrenchment causes adverse effects due to limited drainage and excessive water retention. Damage to tree roots from compaction can reduce health and increase mortality. Indirect influences in some areas include increased erosion, sediment, and stream temperature. Some of these effects can be minimized or mitigated.

Effects by Alternatives for Recreation

Comparisons across Alternatives for developed and dispersed recreational experiences and opportunities are discussed in detail in 3.4.2 Recreation. The total estimated number of campgrounds by development level for Alternative W is 29 (2320 acres). Table 3.4.2G shows a relative decrease in the estimated number of campgrounds by alternatives throughout LBL. This total makes up only 1.35 percent of LBL's total land base. The campground boundaries include some undeveloped forested acres with minimal to no recreational use. Impacts on soil productivity would actually decrease throughout alternatives for developed recreation due to a decrease in development levels of campgrounds. Alternative X would upgrade existing recreational uses and create more opportunities on existing developed recreation areas.

Alternative Y would allow for more dispersed opportunity focus across LBL. Overall, the impacts to soil productivity would be minimal considering seasonal campground closures due to weather; by continuing to maintain trails and other areas for control of erosion; and by applying mitigation measures when and where appropriate.

In Alternative Y there is a possibility of a new campground being built or campsites being designated within the Turkey Bay OHV Area. This activity would have a relative impact on soil productivity for the area dependent upon the development level of the improvements made. Building a campground or designating campsites in Turkey Bay would have a long-term effect on soil productivity with the creation of more facilities and paved parking. However, this impact would be contained within the camping area and would allow for rehabilitation of areas currently used for open camping. Therefore, there would be less area of negative impact to soil productivity than currently exists. Short-term mitigations and improvements will provide protection to the soil resource and continued maintenance, and rehabilitation of the area would provide for protection of long-term soil productivity.

During the LBL plan implementation stage, the trails system within the Turkey Bay OHV Area will be moving towards a designated trail system. Extensive project level planning and implementation for a designated trail system will be the focus for this area throughout the next 10 to 15 years. Designating trails will cause the closure and rehabilitation of some existing user-made trails and various sections of trails that are not located on desired areas of the landscape. Designating trail routes within Turkey Bay will also reduce stream sedimentation and erosion on steep slopes and allow for improvements and proper design of trails at creek crossings. Trail protection or prevention of trail degradation and off-site damages can be accomplished to a large extent by careful selection of trail location, design, graveling, and maintenance. Trail rehabilitation, maintenance, and improvements may require the use of heavy equipment which poses a short term impact on soil productivity. Soil productivity can be enhanced through mitigating these areas in a timely manner and through the proper use of BMPs.

Roads and Trails

According to 36 CFR 212.1, a road is a motor vehicle travel way over 50 inches wide, unless designated and managed as a trail. A road may be classified, unclassified, or temporary.

Classified roads are wholly or partially within or adjacent to National Forest System lands that are determined to be needed for long-term motor vehicle access, including state roads, county roads, privately-owned roads, National Forest System roads, and other road authorized by the Forest Service. Characteristics of classified roads vary with the amount and frequency of traffic. They are specifically designed and located to meet long-term needs, with culverts sized to limit flood risk, and with adequate drainage and erosion control to limit sedimentation. They are maintained regularly with the frequency appropriate for their design, uses, and conditions.

Unclassified roads found on National Forest System lands are not part of the forest transportation system. These include unplanned roads, abandoned travel ways, and off-road vehicle tracks that have not been designated and managed as a trail; in addition, those roads that were once under permit or other authorization.

Temporary roads are authorized by contract, lease, other written authorization, or emergency operation; not intended to be part of the forest transportation system; and not necessary for long-term resource management. Characteristics of temporary roads include: low standard surface; minimum width; generally for single-use access to an area; and are sufficiently blocked to prevent continued use by vehicular traffic or provide permanent road access. The road will be stabilized to prevent erosion and sedimentation, and restored to near original condition after use by seeding within three years. Temporary roads are to be maintained during use (by contractor, permittee, etc.), and typically are not designed to classified standards, so culverts, surfacing and other structures are inadequate for extended uses. When the need for the road is complete, the temporary road is to be closed to all use. The roadbed should then be obliterated or otherwise put in a hydrologically stable condition to prevent erosion and sedimentation and restored to near original condition after use by seeding within three years.

Roads and trails expose and compact soils, alter surface and subsurface water flow patterns, and can alter stream channels during and following construction. Roads and trails directly and indirectly affect water by increasing sedimentation and concentrating run off. Direct effects to soil and hydrology are excavating and compacting soils, filling, placing culverts, and using equipment in streams, riparian, and other sensitive areas.

Stream alterations include channel confinements such as culverts with a localized loss of flood-prone areas and inputs from road surface drainage that include added storm water, sediment, and road traffic pollutants. Open roads contribute higher erosion and sedimentation rates due to ongoing maintenance activities such as surface scraping and shaping, ditch pulling or scraping, and normal wear and tear on the road surface from use. Road surfaces may also contain low levels of vehicle petroleum product pollutants that can be flushed into the aquatic systems during storm events.

Activities associated with closing roads and trails stabilize the road surface when properly drained and vegetated. Some level road and utility corridors are lightly disked to break the surface, then reseeded and mulched to provide linear wildlife strips. Some road closures may inadvertently leave culverts or other road structures. These can become problems unless they were sized and maintained for permanent use. Roads and trails often create problems when located in riparian areas because they are difficult to drain, cause excessive compaction or displacement of soils, alter normal surface and subsurface flows, and increase pollution to streams.

Effects by Alternatives for Roads and Trails

Currently there are approximately 736 miles (approximately 3,554 acres) of roads according to LBL's GIS databases, including approximately 349 miles of Maintenance Level (ML) 3, 4, 5 roads that are suitable for low clearance vehicles (passenger cars). Maintenance Level 2 roads are suitable for high clearance vehicles and are frequently closed for public use. These roads are single-purpose, low-volume roads normally single-lane and un-surfaced. Maintenance Level 1 roads are currently impassable or are blocked to all traffic. The road density at LBL is approximately three miles of road per square mile (LBL Roads Analysis Report, 2003).

LBL has approximately 94, 825 acres of erodible soils, or roughly half of the total land base. Roads intersect these soil types across 4,295 acres. Areas of concern are located on the Baxter-Hammock Complex, Brandon Silt Loam, Bodine Cherty Silt Loam, Nixa Cherty Silt Loam, and Paden Silt Loam soil units. Slope doesn't appear to be much of a factor as these soil units are generally moderate in slope (6-30 percent). Mitigations to reduce erosion and sedimentation are critical on these soil types and may include such practices as mulching, use of geo-technical materials, seeding, directing drainage flows onto vegetated filter strips, catch basins, and routine maintenance (LBL Roads Analysis Report, 2003).

The cumulative effect of management activities involves the additive magnitude, intensity, and timing of human and natural impacts. Each watershed represents a unique history of disturbances as well as a unique sensitivity based upon the natural processes that control and form each landscape (geology, climate, etc.). Because of the nature of road effects on natural processes such as hydrology and sedimentation, they can account for a large proportion of the potential cumulative effects within watersheds. Ultimately, cumulative watershed effects are displayed in the channel's dynamic equilibrium (LBL Roads Analysis Report, 2003).

With increased recreational opportunities and EE facilities (beaches, boat docks/ramps, trailheads) the potential for increases or upgrades in permanent roads and trails exist under Alternatives X and Y. With an increase or upgrade in road density for Alternative X and Y, there would be some long term effects on soil productivity. With additional improvements and maintenance in the short term, there would be minimum long term effects overall.

Motorized trails would stay confined to the Turkey Bay OHV Area only. Since motorized use is confined to the approximately 2200-acre Turkey Bay OHV area (approximately one percent of the spatial area of LBL), effects on soil productivity would be insignificant across LBL. Furthermore, designated trail routes and the continuation of trail rehabilitation, closures, and maintenance within the Turkey Bay OHV Area under Alternative Y, would reduce impacts to the soil and water resources.

Fire Management

Historically, wildland fire has been a natural component to the landscape and can occur under a variety of conditions. Under some conditions, wildland fire is beneficial by removing fuel buildup, promoting a mosaic of wildlife habitat, and rejuvenating some areas for rapid re-growth. Wild land fire can also produce undesired effects to adjacent landowners and the environment (e.g., suppression activities can have direct and indirect soil and water effects primarily from the location and construction of fire lines and firebreaks). Fire lines have many of the effects of skid roads and mitigation measures to limit their effects are similar. Fire lines expose mineral soil and when designed with drainage features such as rolling dips, flow is removed and dispersed into the forest, limiting the effects from erosion and sedimentation. There is often little or no time to plan the best route for constructing fire lines, so mitigation following suppression activities is also important.

Under extreme circumstances that produce a severe burn, all or almost all of the litter, duff, and humus on the forest floor would be consumed, vegetation killed, and mineral soils exposed. Burns of this intensity are unusual occurrences and seldom found across large areas. In localized instances, the mineral soil may degrade by particle fusion or develop a non-wettable soil layer that can restrict water infiltration until it breaks down.

Severe burning can affect soil biota, structure, organic matter, and fertility, potentially triggering accelerated erosion cycling of soil nutrients. Suspended solids, sediments, ash, and nutrients in stream flow might temporarily increase to unacceptable levels in nearby streams during storm run off events.

Prescribed Fire Effects

Prescribed fire is designed to burn with less intensity and less direct and indirect effects to soil and water by removing much of the vegetative cover and litter, while protecting the duff and humus layers of the soil. Under most prescribed fire plans, only a small portion of the soil may be exposed, which may cause concentrated surface flow, erosion, and sedimentation. Prescribed burning goals include measures to maintain soil productivity and erosion control to protect the duff and humus layers on the soil surface. Further measures to provide erosion control include fertilization, seeding, and mulching as needed. Low intensity burns typically do not reduce soil productivity or substantially increase stream sedimentation. However, effects can increase substantially as the burn intensity increases, but these depend also on the soils, slope, topography, rainfall, and cover factors. Fire lines often produce more effects than the fire. Properly designed fire lines effectively limit the effects to soil and water resources. These can be designed for reuse in areas of frequent burning cycles. Location, water, and erosion control are key components in limiting short-and long-term effects to soils and water resources. Re-scraping the surface lightly when the area is to be re-burned will reduce effects. Quality fire lines also allow access during burning and erosion control activities for cost, safety, and environmentally-effective treatments. With prescribed fire activities, fire lines can be placed more carefully on the landscape, prior to or during construction activities, than those constructed for wild land fire suppression.

Prescribed fire impacts soils in two ways. The fire itself burns up portions of the soil's organic layer, an important part of soil productivity. Hotter fires with large fuel loads will burn up more of the organic matter than cooler fires. A few soils in the forest, with thin organic layers, can lose their entire organic layer when a fire burns hot. Typically, these would be shallow, rocky soils, at or near ridge tops on steep slopes. In most cases the effects of fire on the soil are short-termed. Soil organic layers are replenished by leaf fall. Existing vegetation takes advantage of a temporary increase in onsite available nutrients produced by the fire burning organic biomass, which adds new organic material on site.

Associated with prescribed fire is the construction of bladed fire lines to control the burned area boundary. This is considered topsoil removal and is a long-term impact to soil productivity. Not all fire lines are bladed. Non-bladed fire lines are considered short-term impacts to soils.

All alternatives allow for the use of prescribed fire. However, Alternatives X and Y would have the most significant use especially in the Oak-Grassland Demonstration Areas where prescribe burning in conjunction with timber harvesting will be used as a tool to reach the desired condition. Prescribed burning will also be used across alternatives in open land areas for native vegetation restoration and for the eradication of non desirable plant species.

3.1.3 Watershed

Affected Environment

The water resources at LBL consist of wetlands, streams, springs, interior lakes, ponds, wildlife watering holes, and groundwater. Kentucky Lake to the west, an impoundment of the Tennessee River, and Lake Barkley to the east, an impoundment of the Cumberland River, are not considered part of LBL. The lakes provide a number of recreational opportunities to LBL visitors. Kentucky Lake and Lake Barkley are included in the resource description because surface water run off from LBL ultimately drains into them.

The U.S. Army Corps of Engineers, Nashville District, has jurisdiction over the management and operation of all lands and water comprising the Lake Barkley project. This includes regulatory and navigational responsibilities. The Corps also has regulatory and navigational jurisdiction on Kentucky Lake and the Tennessee River. However, TVA has regulatory jurisdiction on waters within the Tennessee River watershed, and operates Kentucky Lake.

LBL is roughly divided into two equal portions separated by the Tennessee/Cumberland drainage divide, which runs roughly north/south down the longitudinal center of the peninsula. Generally, LBL drains from east to west for the Tennessee River drainage portion, and from west to east for the Cumberland River drainage portion. LBL’s approximately 79 watersheds are relatively small and range from about 600 to 4,000 acres in size. The small sizes are the result of the relatively short distance from the drainage divide to either of the two impounded rivers. As a result of these drainage features, the majority of LBL's streams have seasonal flows.

Water Resources

Streams

The National Wetlands Inventory Mapping System (NWIMS) subdivides the three types of LBL streams (perennial, intermittent, and ephemeral) as follows:

- <u>Perennial Streams</u> are any watercourse that generally flows most of the year, in a well-defined channel that is below the water table. Droughts and other precipitation patterns may influence the actual duration of flow. Perennial streams contain fish or aquatic insects that have larvae with multiple year life cycles. Water dependent vegetation is typically associated with perennial streams.

Bear Creek and Lost Creek, located on the south end of LBL, are perennial streams and the only streams with portions of their watersheds extending outside LBL's boundary. The largest perennial stream watersheds are Crooked Creek and Bear Creek. Lost Creek, Brandon Spring Branch, Barrett Creek, South Panther Creek, Byrd Creek, South Crockett Creek, Prior Creek, Long Creek (Barnes Hollow), and Fulton Creek are streams having perennial sections in their lower reaches.

- Intermittent Streams flow in response to a seasonally-fluctuating water table in a well- defined channel. The channel will exhibit signs of annual scour, sediment transport and other stream characteristics, absent perennial flows. Intermittent streams typically flow during times of elevated water table levels and may be dry during significant periods of the year, depending on precipitation cycles. Field identification of intermittent streams must consider geology, land use patterns, and precipitation cycles. Intermittent streams do not maintain fish populations year around or aquatic insects that have larvae with multiple year life cycles.

- Ephemeral Streams are typically defined by flows that occur for short periods of time in direct response to storm precipitation or snowmelt run off. Ephemeral stream bottoms are always above the water table and do not contain fish or aquatic insects that have larvae with multiple year life cycles. Ephemeral streams may or may not have a defined channel. Ephemeral streams may serve as a conduit for much of the sediment that enters the stream system network. Large woody debris associated with ephemeral streams may also contribute significantly to the stability of the stream system. The NWIMS does not classify any ephemeral streams on LBL as wetland areas.

The biological characteristics of LBL streams have received little study. However, in July 2001, the U.S. Forest Service Center for Aquatic Technology Transfer (CATT) performed surveys on 11 streams flowing into Lake Barkley and Kentucky Lake. The CATT team inventoried stream habitat, fish, macro-invertebrates, sediment, and water chemistry to provide LBL managers with baseline data needed to develop resource management plans. The streams that were surveyed include Curry Hollow, Barnes Hollow, Crooked Creek, Pryor Creek, Crockett Creek, Barret Creek, Brandon Spring Branch, and Bear Creek. These eight perennial streams are part of the Cumberland River Drainage. The remaining three perennial streams on LBL are part of the Tennessee River Drainage and include Byrd Creek, Panther Creek, and Lost Creek. The data from the CATT report was used in development of the cumulative effects model to set the threshold for watershed condition ranking. Refer to Appendix B.12 (Sediment Yields and Cumulative Effects for Water Quality and Associated Beneficial Uses).

Ponds and Wildlife Watering Holes

Ponds at LBL range from one-quarter to three acres in size. Of LBL's approximately 300 ponds, most were constructed by former landowners. The biological characteristics of LBL's ponds have received little study.

Since 1966, approximately 500 wildlife watering holes have been constructed. Generally about one-tenth acre in size, watering holes are spaced throughout LBL at approximately half-mile intervals to provide well-dispersed water supplies for wildlife.

Walter (1988) studied the characteristics of wildlife watering holes and their use by wildlife in Hunt Area 5 (Tennessee drainage) and Hunt Area 10 (Cumberland drainage). He found 24 percent of the watering holes in the Tennessee drainage were dry, whereas 57 percent were dry in the Cumberland drainage. (It should be noted that this study followed four to five years of below average rainfall for the region.) Although 60 percent of the studied ponds were free of aquatic vegetation, cattails and pondweed were the dominant vegetation types in those ponds that contained aquatic vegetation. Wildlife using the ponds most were deer, turkey, and raccoon. Use was also recorded for bobcat, coyote, mink, squirrel, and shorebirds. Boehler (1989) studied wildlife watering holes in Hunt Area 3 (Tennessee drainage) and Hunt Area 7 (Cumberland drainage) and found results similar to Walter (1988) in terms of pond characteristics and wildlife usage (TVA, 1994).

Kentucky Lake and Lake Barkley

Kentucky Lake and Lake Barkley (218,000 acres combined) are the last downstream impoundments on the Tennessee and Cumberland Rivers, respectively. The two lakes are connected near their dams at LBL's north end by Barkley Canal, a 1.75-mile navigation canal. The canal helps maintain annual water level fluctuation regimes for both lakes that are nearly identical. Summer pool elevation is 359 feet above sea level for only a two-month period, May and June. The lakes are held at winter pool elevation (354 feet) for a four-month period, December through March. During April, the lakes are filled from winter pool to summer pool. From July through November the lakes are drawn down slowly in stages to reach winter pool by December 1.

The five-foot fluctuation zone for Kentucky Lake and Lake Barkley represents a significant ecological zone. Fluctuation zone areas are most extensive in the backs of embayments where creeks carry and deposit sediments. Many of these areas are mudflat wetland habitats. Chester (1992c) describes these "seasonal dewatered flats" as having diverse plant community associations, finding 65 species of vascular plants on 30 such areas of Lake Barkley. Of these, 52 species were native and 13 were introduced species. Sixty-eight percent were annual plants. These fluctuation zone plants provide waterfowl and shorebird food during early spring and summer (TVA, 1994).

Lakeshore makes up 96 percent of LBL's boundary (about 300 miles of lakeshore edge compared to 12 miles of private property edge). Fifty-eight of the largest LBL embayments receive run off from 82 streams. The volume of surface water run off from LBL is small relative to total volume of run off entering Kentucky and Barkley Lakes from other drainage areas. LBL's 79 watersheds average only about 2,000 acres each in size.

Interior Lakes

LBL has five constructed interior lakes totaling approximately 887 acres. Energy Lake (approximately 330 acres), Bards Lake (approximately 250 acres), and Honker Lake (200 acres) are sub-impoundments (impounded embayments) of Lake Barkley. Low-level dams were constructed across embayments in conjunction with the impounding of Lake Barkley in the mid-1960s to create smaller lakes to provide stable water levels for water-based recreation at three LBL facilities: Energy Lake Campground; Brandon Spring Group Center; and the Youth Station Resident Center (now closed). These lakes become connected to Lake Barkley during flood stage about once every three years.

Hematite Lake (90 acres) was constructed in the early 1940s. Duncan Lake (12 acres) was impounded in 1980 and is used for limited-access recreational fishing associated with special groups. These lakes are managed primarily to enhance habitat for waterfowl and shorebirds, and provide fishing and wildlife viewing opportunities. Non-motorized boats and boats powered by electric motors are permitted on Hematite Lake. No boats are currently allowed on Duncan Lake.

Water Quality

In order to better characterize the waters of the state and better coordinate resources toward addressing problems, the Kentucky Division of Water (DOW) and Tennessee Department of Environment and Conservation Division of Water Pollution Control adopted a Watershed Management Framework in 1997. The purpose of this management framework is to use programs, people, information, and funds as efficiently as possible to protect, maintain, and restore water and land resources.

To fulfill requirements of Section 305(b) and 303(d) of the Federal Water Pollution Control (or Clean Water) Act of 1972, the Kentucky Division of Water and the Tennessee Department of Environment and Conservation (DOWPC) prepares a report every two years for submittal to the US Environmental Protection Agency (EPA). Section 305(b) of the Act requires states to assess and report current water quality conditions. Pursuant to Section 303(d) of the Clean Water Act, the States of Kentucky and Tennessee have developed a list of water bodies presently not supporting designated uses as required by 40 CFR 130.7(b)(4) and needing total maximum daily load (TMDL) development. (KY 303(d) NREPC, 2003 and TN 303(d) DWPC, 2002)

According to the 1998 303(d) Report, Honker Lake is in partial support of aquatic life designated use because of nutrient deficiencies. However, the latest assessment information shows that the lake now fully supports the aquatic life use (KY NREPC, 2002). The lake is currently delisted in the 2002 303(d) Report as a second Priority Listing.

Stream segments identified as nonsupportive of one or more designated uses are classified as firstPriority in the 303(d) Report. Stream segments identified as being in partial support of one or more designated uses (but not nonsupport of any use) are classified as second Priority in this report.

According to the 2002 305(b) Report, Turkey Creek and Crooked Creek are fully supporting designated uses for warm water aquatic habitat (WAH). Energy Lake and Honker Lake are fully supporting designated uses for WAH, primary contact recreation (PCR), and secondary contact recreation (SCR). However, according to this report Hematite Lake (not supporting) is listed as an impaired designated use for WAH.

The Mid-America Remote Sensing Center (MARC) recently conducted research of the Turkey Bay OHV Area to determine impacts resulting from recreational activities. The tasks addressed in this research were threefold:

- To evaluate turbidity in Kentucky Lake, Turkey Bay in particular, using data collected by the Kentucky Lake Monitoring Program (KLMP) of Murray State University's Center for Reservoir Research;
- To map turbidity with Landsat Enhanced Thematic Mapper Plus (ETM+) data, and;
- To map randomly selected areas of disturbance in the OHV area using high-resolution, color aerial photography.

Assessment of water clarity and turbidity within Turkey Bay was compared to three other bays monitored by KLMP (Vickers Bay, Ginger Bay and Highland Light). Data suggest that water clarity, as assessed by turbidity and Secchi depth, are not measurably different in Turkey Bay as compared to the other sites within Kentucky Lake Reservoir. Analysis of Landsat ETM+ data showed that Turkey Bay did have a higher-than-average mean turbidity for five dates in 2000 and 2001 when compared to the three embayments on the east side of the reservoir. However, this higher-than-average turbidity was generally consistent with the relationship between east embayment mean turbidities and mean depth, (i.e., the shallower the embayment, the higher the turbidity) (Kipphut, et al, April 2004).

Sedimentation

Non-point source pollution is a major concern related to natural resource management throughout the United States. Undisturbed forest lands typically show minimal erosion, less than 0.13 ton/acre (0.30 ton/hectare), due to the increased cover and surface roughness found in these areas. However, disturbances caused by forest management practices can result in accelerated erosion losses and stream sedimentation. Forest management activities were identified by the Clean Water Act (CWA) of 1977 as source activities for non-point source pollution. Soil erosion and sedimentation resulting from forest operations remain a concern in forest management. Activities with the potential to cause detrimental impacts on water quality due to soil erosion and sediment delivery to stream systems include road activities, harvesting, site preparation, fertilization and fire management (Grace III, 2002).

Research conducted in various geographical areas clearly shows roads as a major contributor to erosion and stream sedimentation on forested lands. Concentrated flow, reduced infiltration, increased slopes, removal of surface cover and interception of subsurface flow are a few factors that can contribute to the increased erosion potential of forest roads. Each of these factors can contribute to increasing run off energy to detach and transport sediment by increasing the volume and/or the velocity of storm run off. Soil eroded from the forest road prism can be delivered directly to forest stream systems causing adverse impacts on water quality (Grace III, 2002). State BMPs and/or the R8 SWCPG should be used for mitigating effects to the soil and water resources and to assure that water resources meet the intent of the CWA.

Road networks in LBL are the most significant source of LBL management-accelerated delivery of sediment to streams, Kentucky Lake, and Lake Barkley. Roads can contribute to sedimentation through surface erosion, unstable cut and fill slopes, drainage structure fills, and non-vegetated drainage ditches and shoulders (LBL Roads Analysis Report, 2003). Although road networks in LBL are the most significant source of sediment delivery to streams, timber harvesting, open lands management, and recreational activities have contributed to stream sedimentation as well.

Groundwater

Surfacing groundwater creates many spring up-wellings at LBL. In 1969, LBL springs were surveyed and categorized as being "free-flowing" (perennial), "trickle-flowing" (perennial), "seep" (intermittent), or "seasonal" (intermittent). Free-flowing springs flow continuously throughout the year. Trickle-flowing springs flow throughout the year, but with a low water volume. Seep springs flow with enough frequency to maintain small standing pools which seldom dry up, and seasonal springs are dry part of the year. The survey identified 131 springs, of which 19 were free-flowing, 29 were trickle-flowing, 34 were seep, and 49 were seasonal springs. These springs are protected by LBL management. While they are limited in area, they are rich in species biodiversity (TVA, 1994).

In 1988, Dr. Steven W. Hamilton of Austin Peay State University initiated a quarterly spring survey of eight of LBL's largest springs to characterize these environments. In 1989, two additional springs were added to the survey. Samples of aquatic invertebrates are taken in addition to measurements of temperature, pH, dissolved oxygen, width, depth, and flow rate. Measurements are made in, around, and 30 feet below each spring source. Publications are in progress; however, preliminary results indicate stream waters are of high quality for the parameters tested (TVA, 1994).

LBL's largest free-flowing spring is Lost Creek Spring located in the Tennessee portion. Lingle-Gillis and Hamilton (1990) describe it as a temperate, calcareous spring with an average temperature of 58° F and discharge volume of 14,100 cubic feet per hour at the source. The researchers found 90 species of aquatic invertebrates in the spring, most represented by species of insects, snails, and crayfish. LBL's second largest spring, Prior Creek Spring, had a discharge of 1,940 cubic feet per hour (14 percent of Lost Creek Spring's flow) and approximately 50 percent fewer species of invertebrates than those found in Lost Creek Spring (TVA, 1994).

Water Quantity

Harris (1988) described the climate for the region as "temperate continental." Summers are hot and humid, evaporation is high, and soils are dry. Mean annual temperature for the region is 58° F. Mean temperatures during the winter and summer seasons are 38° and 76° F, respectively. July is the hottest month with an average daily high temperature of 90° F, and January is coldest with an average daily low temperature of 25° F. Temperature extremes range from -10° F to 102° F (TVA, 1994).

Annual precipitation averages 46 inches, with 22 inches accumulating during the five-month growing season from early April to early September. There is no distinct rainy season. Most winter season precipitation is in the form of rain. Although total rainfall in the summer season is about the same as in the winter, the effects of evapotranspiration and evaporation during the summer cause most LBL streams and springs to cease flowing. There are 45 to 50 rainfall events per year, and high intensity rains of four to six inches are common. These storms fill waterways rapidly, scouring substrates as the water recedes very quickly.

Consumptive and Non-Consumptive Use

LBL contains facilities with drinking and wastewater systems in its three counties (Stewart County, TN, Trigg County, KY, and Lyon County, KY). The Stewart County portion of LBL has nine operational facilities with drinking water systems and two waste water systems. On the Kentucky side, Trigg County has eight operational facilities with drinking water systems and Lyon County has six. There is one Kentucky wastewater system located within LBL in Lyon County.

Tables 3.1.3A and 3.1.3B list all the facilities on LBL with drinking and wastewater systems by county. A public water system identification number is attached to each facility and a National Pollutant Discharge Elimination System number is attached to each wastewater system with sizes of each in million gallons per day (MGD). Gallons used are totals derived for each system from October 2002 through September 2003 (annual readings).

Table 3.1.3A Tennessee Water Systems

Stewart County:	PWSID	Gallons
Boswell Landing (closed)	**0004185**	
Brandon Spring (2 wells)	**0004186 (B well pending waiver)**	**2,865,230**
The Homeplace	**0004193**	**533,100**
Piney Campground B	**0004187**	**744,730**
Piney Campground CD	**0004188**	**1,541,400**
Piney Campground E	**0004184**	**1,106,790**
Rushing Creek	**0004190**	**221,870**
South Welcome Station	**0004195**	**102,920**
South Maintenance Shop	**0004194**	**127,390**

Tennessee Wastewater Systems

Stewart County:	NPDES	Size	Gallons
Brandon Spring package plant	**TN0020273**	**0.018 MGD**	**1,446,196**
Piney C D E sand filter	**TN 0020249**	**0.045 MGD**	**2,241,235**

Table 3.1.3B Kentucky Water Systems

Trigg County:	PWSID	Gallons
Administrative Building	1112221	420,130
Energy Lake Campground	1112365	578,190
Duncan Bay	1112306	47,890
Fenton Lake Access	1112486	66,450
Golden Pond Visitor Center	1112871	1,209,860
Maintenance Complex	1112364	228,150
Off-Highway Vehicle Area	1113460	116,900
Wranglers	1112837	6,242,400

Lyon County:	PWSID	Gallons
Birmingham Ferry	1112214	78,130
Cravens Bay (The well is non-operational, a well house is being built)- Back in service	1112212	75,500
Hillman Ferry A & B wells	1112211	A- 1,486,400 B- 1,980,320
Nickell Branch (closed)	1112532	
North Welcome Station	1112210	208,530
Woodlands (Nature Station)	1112213	245,880

Kentucky Wastewater Systems

Lyon County:	NPDES	Size	Gallons
Hillman Ferry package plant	KY0020192	0.050 MGD	3,884,295

Non-Consumptive Water Uses

Non-consumptive water uses are those that do not consume or remove water from a water body. These include instream flows for streams and water levels in lakes and reservoirs. Instream flows are necessary to fulfill the purposes for which national forests were created and to meet the intent of applicable laws and regulations. These purposes include favorable conditions of water flow, fish and wildlife, recreation, and aesthetics. Instream flows are also needed in adequate quantities to support the beneficial uses designated by the State. Commonly-listed beneficial uses (known as designated uses in some states) for non-consumptive purposes include recreation, fish and wildlife, and aquatic life.

Management of LBL requires instream flows that provide sufficient water flow to maintain the capacity of the channels to transport water and sediment. Favorable conditions include the volume and timing of flows required for adequate sediment transport, maintenance of stream bank stability, and proper management of riparian vegetation.

Riparian Areas and Corridors

Riparian areas are three-dimensional ecotones of interaction that include terrestrial and aquatic ecosystems that extend down into the groundwater, up above the canopy, outward across the floodplain, up the near slopes that drain to the water, laterally into the terrestrial ecosystem, and along the water course at a variable width.

Riparian corridors are management prescription areas used in other R8 forests' Plans. These prescriptions are designed to include riparian areas and stream management zones, and are specified to maintain riparian functions along perennial and intermittent streams. Ephemeral streams do not support the aquatic life and other riparian area characteristics, and have been taken out of the definition of riparian areas. The states of Kentucky and Tennessee BMPs, along with TVA's 1994 Plan, address streamside management zones as designated areas for protection of water quality along perennial and intermittent streams.

In all alternatives, riparian corridors of native vegetation will now be maintained along each side of perennial and intermittent stream courses in order to maintain fluvial and riparian functions. Corridors along perennial streams are defined as 100 feet measured from bankfull stage. Corridors along intermittent streams are defined as 50 to 75 feet measured from bankfull stage at a minimum. When a 50 foot corridor is used, a minimum of 20 feet adjacent to management activities is a maintained native grass vegetative filter strip. The remaining corridor is shrubs and trees. Without a native grass vegetative filter strip, the minimum corridor along intermittent streams is defined as 75 feet of natural vegetation. A site specific field review may result in a change of these fixed widths.

Current Conditions of LBL Streams

Erosion by running water has etched LBL's landscape and created dissections of today's streams. The retreat of discontinuous gullies (headcuts) is the most active and obvious erosional process within LBL. The sequence of headcuts up the channels may be analogous to the scour and riffle sequence of larger stream channels and a natural process. Sediment is transported downstream in this manner of scour and fill. Active erosion against stream valley slopes and across the mouths of tributaries is causing deepening of the tributary channels. Changing base elevation from pool levels of the lakes exacerbates the process. Coarse gravels entrained during run off events are spread farther out into the bays at times of low water than would be true if normal levels were maintained.

LBL streams transport great quantities of gravel, which are often carried onto valley floors during heavy rainfall followed by high run off. This is a natural condition which is unavoidable due to the gravelly nature of the soil and topography. Gravel often piles up against obstructions such as logs, culverts, and bridges. Stream beds are scoured and gravel bars shifted, resulting in streams with very unstable ecosystem conditions (TVA's 1994 Plan). Pebble counts were performed at a total of 33 sites in the 11 perennial streams during the CATT team survey. Stream substrates were found to be generally rocky in the upper to middle reaches of their water courses and sandy to muddy near their mouths.

Channels generally are stable laterally. This is due to heavily forested watersheds that store and release run off, while traditional lower stream segments are inundated by the lakes. Lateral migration of the lower segments of streams is a natural process, and current migrating channels are within historic levels. Channels are not generally stable in their vertical profile and continue to downcut and deepen their gullies. This adds to normal bedload quantities. This bedload, along with debris, is often dropped in lower gradient sections of the stream and may cause the stream to migrate laterally. Large woody debris embedded in the channel is one natural process that stabilizes the stream, dissipates flow energy, and adds habitat for aquatic life. There appears to be less large wood within LBL streams than would normally be expected. This may increase the downcutting of channels and increasing bedload movement.

These localized stream channels that the watershed modeling did not portray will be identified at the project level and mitigated based on Regional SWCP guidance, state BMP utilization and other appropriate direction. Also, within the next 10 to 15 years improvements will be made to priority sixth Level hydrologic unit code (HUC) watersheds by one condition class based on results from the Area-wide Roads Analysis and Watershed Assessment modeling.

Given that dewatering seemed to have detrimental effects on community diversity, the CATT survey indicated any activity that removes water from LBL's streams should be limited, especially during low flow periods. High levels of substrate embeddedness were found in some streams. Water chemistry results from the CATT survey were generally acceptable, but the survey recommends repeated sampling to verify results at sites with low pH (less than 6.5). In addition, sites with relatively high conductivity levels could indicate areas with increased levels of pollutants. The CATT report concluded these areas should be sampled again to verify readings or be monitored in the future. (CATT, 2002).

Direct and Indirect Effects

Activities affecting water quality on LBL includes roads and trails, open lands management, fire management, and vegetation management activities. These resource management activities can affect water quality through sedimentation, erosion, and surface run off.

LBL's greatest potential for impacts to water quality are likely from soil loss and sedimentation to streams, which receive run off primarily from LBL's maintenance level 2 and 4 roads, and land management practices. Sedimentation could also impact ponds, wildlife watering holes, and springs (LBL Roads Analysis Report, 2003).

Roads and Trails

Roads and trails directly and indirectly affect water by increasing sedimentation and concentrating run off. Roads and trails expose and compact soils, alter surface and subsurface water flow, and can alter stream channels during construction. When left open they will contribute to higher erosion and sedimentation rates than closed roads and trails.

Road networks in LBL are the most significant source of management-accelerated delivery of sediment to streams, Kentucky Lake, and Lake Barkley. In addition to acceleration of sedimentation, there are numerous direct and indirect impacts to aquatic systems associated with road construction and management. While some of these impacts have positive benefits such as accessibility to recreation facilities, open lands, the general forest, or the protection of watersheds from catastrophic wildfire, roads have unavoidable effects on streams, wetlands, and riparian areas no matter how well they are located, designed, and maintained (LBL Roads Analysis, 2003).

Many roads are located along stream channels or within their valleys because of gentle slopes and easier construction. About 268 miles of roads encroach upon the stream network. Most locations are distributed evenly along headwaters and main channels of watersheds across LBL. However, high miles of road encroachment are noted along headwaters of Crooked Creek and Lick Creek. Two major roads, The Trace and US Highway 68, encroach upon numerous streams along their routes (LBL Roads Analysis, 2003).

Road crossings and running prisms within floodplains, wetlands or encroaching on stream channels can intensify run off events and increase sediment input to the streams. Many roads are located along stream channels or within their valleys to take advantage of gentle slopes and easier construction. Culverts were installed at many of the stream crossings and never designed to pass more than a 25-year interval event. Streams entrain and transport enormous amounts of cherty fragments, adding to flow volumes that these culverts were never designed to accomodate. Washout and breaching of culverts are common after major run off events. Other culvert installations have channelized flows and increased velocities resulting in scour below the outlet. This exacerbates downcutting of the stream channel (LBL Roads Analysis, 2003).

There are approximately 509 locations where Level 3, 4, and 5 roads cross streams within LBL. A large number of crossings occur in Barrett, Bear, Crooked, Lick, Lost, Furnace, Turkey, Panther, and Pryor Creek watersheds. Most roads discussed in the LBL Roads Analysis have paved or aggregate surfacing and are maintained. Nearly all roads have existed for more than 10 years and many for more than 30 years. Proper maintenance reduces the production of sediment and the risk of it being transported to the streams. Paved surfaces (Level 5) produce the least amount of sediment. Aggregate surfaced roads (Level 4) have reduced levels of sediment relative to native surface roadways. However, limestone aggregate used on most of LBL's roads breaks down into fine particles over time with heavy use and can contribute to available sediment load. Proper grading techniques, drainage of the road prism, and replacement of surfacing reduces the amount of sediment to streams. Native surface roads contribute the most sediment since they are vulnerable to rutting. There are seasonal closures on some roads for wildlife habitat protection that has beneficial indirect effects to the soil and water resources (LBL Roads Analysis, 2003).

According to the LBL Roads Analysis, there are locations where increased risks to aquatic and wetland resources are sufficient to warrant modification to road administration or infrastructure. Two sixth level watersheds (Crooked and Lick) have increased risk due to sediment and cumulative watershed effects on ecosystem processes and/or habitat. Five wetlands (Davenport Bay, Willow, Honker, Crooked, and Devil's Elbow) have increased (high) risk due to roads directly crossing wetlands, impacting the hydrology and ecosystem processes and/or habitat. Four wetlands (Turkey, Barnett, Lost, and Laura Furnace) have increased (moderate) risk due to roads being within 100 feet of a wetland and potentially impacting the hydrology and ecosystem processes and/or habitat.

Some recommendations for improving the roads system can include changes in road maintenance objective (RMO) levels, reconstruction, and decommissioning. A reduction of an RMO from a Level 2 to a Level 1 may need to be considered to place a particular road in such a condition that it can be self-maintaining. Work required may include reshaping to an out-sloped configuration, removing culverts and fills, or replacing culverts with rock-armored dips or rock fills. Reconstruction or relocation of roads to an out-sloped or crowned template where road surface drainage is dispersed over the full length of the road prism not only reduces maintenance needs, but also typically minimizes the adverse impacts often associated with the concentration of surface run off. Utilizing designs that lay gently on the land and avoid steep slopes, erosive soils, and hydrologic connectivity will also minimize road impacts. The identification of unneeded roads and of feasible maintenance levels would best be accomplished on a road-by-road basis at the project or watershed scale of analysis. All considerations and/or recommendations discussed will require site specific and detailed analysis on a road-by-road basis.

Vegetation Management

Vegetation management activities that affect soil and water include timber harvesting, site preparation, timber stand improvement projects, and skid trail construction. Loss of the protective soil cover (litter) from ground disturbance can increase erosion and sedimentation while decreasing soil productivity. Water yield also increases because of reduced transpiration and raindrop interception.

Fire Management

Prescribed fire effects water quality in various ways, depending on fire intensity, type and amount of vegetation present, ambient temperature, terrain (slope, aspect. etc.), and other factors (Stanturf *et. al.,* 2002). The main effect of prescribed burning on the water resource is the potential for increased runoff of rainfall. When surface runoff increases after burning, it may carry suspended soil particles, dissolved inorganic nutrients, and other materials into adjacent streams and lakes reducing water quality. However, most studies in the South indicate that effects of prescribed fire on water quality are minor and of short duration when compared to forest treatments and practices (Stanturf *et. al.,* 2002).

Even the most intense prescribed fires, in some instances, disturb the root mat very little and very seldom consume all fuel available. Therefore, root mat, residual fuels (unburned leaf and limb material), and incompletely consumed large fuels (such as larger limbs and logs) form debris dams that inhibit sediment transport (Dissmeyer and Foster, 1980).

Cumulative Watershed Effects

In order to comply with planning requirements (36 CFR.219.23) (1982) for effects analysis on aquatic resources, Section (d) of the aquatic resources section requires that forest planning provide for an evaluation of existing or potential watershed conditions that will influence soil productivity, water yield, water pollution, or hazardous events**.**

With this current level of planning, available data layers, and GIS information were used, following a similar exercise for the Southern Appalachian Forest Plans, to specifically evaluate watershed condition and estimate the effects of management activities based on a number of watershed parameters. The results of sediment yield and an index of disturbance were directly related to overall watershed condition or health. The process provides an objective process to systematically evaluate water quality conditions for watersheds covered in whole or part by the Area Plan. The process also provides results that can aid in aquatic viability analysis at the community scale.

Cumulative Effects

The analysis of cumulative impacts is a requirement of NEPA. A cumulative impact analysis should consider incremental impacts of actions when added to past, present, and reasonably foreseeable future actions. The analysis includes all actions regardless of who undertakes the actions. Cumulative impacts can result from individually minor but collectively significant actions taking place over time.

"A cumulative effect is the impact on the environment which results from the incremental impact of the action when added to other past, present, and reasonably foreseeable future actions, regardless of what agency (Federal or non-Federal) or person undertakes such other actions. Cumulative effects can result from individually minor but collectively significant actions taking place over a period of time" (40 CFR 1508.7).

Sediment is an appropriate measure to determine the effects of management activities on water quality and its associated beneficial uses on forested lands (Coats and Miller, 1981). Sediment increases can adversely affect fish productivity and diversity (Alexander and Hansen, 1986), degrade drinking water and affect recreational values. There may be other cumulative impacts such as increases in water yield as a result of harvesting methods. However, water yield models do not characterize the impacts of all management activities such as road construction and the increase in water yield is generally less than the natural variability. Changes in water nutrients or nutrient fluxes within streams as a result of management activities are minor and not an appropriate consideration of cumulative effects at the Area Plan level. The model used predicted sediment yields as the surrogate for determining cumulative impacts for water quality.

Changes in land use and disturbance were modeled with respect to estimated increases in sediment, and predicted impacts were summarized by alternative. The significance of predicted impacts was then related to criteria designed to determine levels of watershed health.

Bounding the Effects Analysis

A valid cumulative effects analysis must be bounded in space and time. For the purposes of this analysis, watersheds are the appropriate spatial bounds for cumulative effects. The implementation period for a forest plan is five to 15 years, however the appropriate time period captured for the sediment model is for five decades (50 years). This allows for a discussion of past, present, and future activities for public and private lands by watershed over a 50 year period.

Modeling Sediment Yield

A summary of the data sources, steps used and determination of sediment coefficients can be found in Appendices B.12 and B13 of this document. The same appendices also include the Fish Community/Sediment Profile relationships that were used to determine thresholds for watershed health.

The summary worksheet of the sediment model calculates the baseline, current, and predicted sediment values for each watershed by alternative and period. To determine the potential cumulative effects of water quality and associated beneficial uses, these sediment values are expressed as a percent increase over the baseline. The baseline assumes an undisturbed forest floor with no roads. It should be recognized that using such a baseline will result in high percentage increases since baseline values can indicate little to no erosion or sediment. The percentage values are only used as a mathematical index and should not be viewed as an indication of effects or impairments. This becomes clearer when the interpretation of this information is captured in a process call the Watershed Condition Rank (WCR) as described below.

Watershed Condition Rank (WCR)

Watershed Condition Rank is a measure that characterizes the conditions of watersheds with respect to current and future sediment load increases.

In order to establish WCRs, the current sediment average annual yield is determined and expressed as a percent above the baseline conditions. This provides a relative measure to determine changes within watersheds. The next step in this process is determined by using the relative abundance of locally adapted species with respect to predicted sediment increases to create a species-sediment load relationship or index (SSI). This score is modified by a weighted average where the watershed occurs in more than one physiographic zone. Watershed condition is generalized into three categories of excellent, average, and below average. The SSI, however, does not necessarily translate into an excellent or poor watershed but broadly categorizes the watersheds based on the sediment prediction/aquatic viability relationship. The SSI is a relatively large-scale coarse filter developed to evaluate alternatives in forest plans and to establish priority work at the planning scale. Therefore, further detailed analyses of the watershed will be conducted at the project level.

From the WCR a series of determinations can be made that assign further analysis at project level. The following section details the outcome of the WCR with respect to adverse effects on aquatic biota as they are related to forest management:

- Where a watershed SSI is ***excellent***, the probability (or potential) is **low** for adverse effects to aquatic species. If the results of forest alternatives remain within this range there should be no adverse effect on water quality with respect to beneficial uses (fish communities). Forest Service objectives would be to maintain or improve aquatic health through the implementation of riparian prescriptions. The threshold for this condition was determined to be below a 600 percent sediment increase over natural baseline. Refer to Appendix B.12 (Sediment Yields and Cumulative Effects for Water Quality and Associated Beneficial Uses) for more information on fish community and sediment profile;

- Where a watershed SSI is ***average,*** the potential to adversely affect beneficial uses is **moderate**. Additional analysis and assessment should be considered.

Examples would be conducting watershed assessments during project planning to identify the source of the problem, and monitoring prior to project implementation to determine the actual health of the biota. The threshold for this condition was determined to be between 600-1200 percent sediment increase over natural baseline;

- Where a watershed with an SSI is ***below average***, the potential to adversely affect beneficial uses is **high**. In addition to points listed above, management objectives at the project level would seek to maintain or restore watershed health and aquatic systems where the Forest Service can make meaningful contributions to watershed health. This threshold for this condition was determined at over 1200 percent sediment increase over baseline.

Assumptions, Uncertainties, and Limitations

Many assumptions are made throughout the sediment model and the WCR. Every effort has been made to describe those assumptions and minimize misrepresentation. With that in mind the application of the sediment model and associated WCR should not be taken as absolutes but as a method that can describe the effects from the range of alternatives and suggest where a greater risk with respect to water quality and aquatic biota exists. This process is developed for the forest plan level. It should be noted that studies completed by MacDonald (1999), calculated confidence intervals of +/- 200 percent when modeling sediment due to the stochastic nature of sediment movement through a stream system.

Most watershed models were developed for fifth level Hydrologic Unit Code watersheds, large watersheds encompassing 40,000 to 150,000 acres. In LBL's case, because of truncated drainages, the size of modeled watersheds was at the seventh level HUC, averaging 2,000 to 3,000 acres. At this scale, high erosion rates may overestimate erosion from typical Forest Service activities. Therefore, the results should be viewed as "worst case scenario." Thresholds were determined for WCR using site-specific stream and aquatic species field data and would be calibrated for small watersheds. The field data was collected only on perennial streams.

Watershed condition is an accumulation of disturbance across the entire watershed and is expressed at the outfall of that watershed. Following is an example of spreadsheet data and the WCR based on the current condition and the potential effects of each alternative for the first 10-year period, which, are also mapped in Appendix B.13.

Table 3.1.3C Cumulative effects analysis for water quality and associated beneficial uses for period 1

Watershed number	Current Condition (expressed as percent increase)	Current health (excludes fire and forest management activities)[1]	Alt W	Alt X	Alt Y	Alt Z	Alt W	Alt X	Alt Y	Alt Z
			Percent increase above baseline				Watershed Health for Period 1			
1	207	E	218	224	225	194	E	E	E	E
2	192	E	202	207	208	189	E	E	E	E
3	113	E	124	129	129	122	E	E	E	E
4	149	E	161	166	167	159	E	E	E	E
5	293	E	305	312	313	240	E	E	E	E
6	241	E	251	256	256	196	E	E	E	E
7	376	E	388	395	395	330	E	E	E	E
8	698	A	713	722	722	685	A	A	A	A
9	214	E	229	238	239	187	E	E	E	E
10	324	E	341	351	352	261	E	E	E	E
11	292	E	308	317	317	257	E	E	E	E
12	301	E	312	321	320	259	E	E	E	E
13	189	E	202	210	211	182	E	E	E	E
14	213	E	226	234	235	201	E	E	E	E
15	420	E	432	440	440	322	E	E	E	E
16	193	E	193	193	193	154	E	E	E	E
17	210	E	212	214	214	177	E	E	E	E
18	275	E	287	276	276	223	E	E	E	E
19	1,088	A	1,098	1,090	1,090	1,019	A	A	A	A
20	110	E	110	110	110	110	E	E	E	E
21	236	E	247	254	254	196	E	E	E	E
22	176	E	176	177	177	177	E	E	E	E
23	333	E	344	347	347	270	E	E	E	E
24	304	E	308	309	309	232	E	E	E	E
25	200	E	207	202	202	161	E	E	E	E
26	1,138	A	1,144	1,139	1,139	149	A	A	A	E
27	2,613	BA	2,613	2,613	2,613	108	BA	BA	BA	E
28	174	E	183	175	176	175	E	E	E	E
29	175	E	182	176	176	176	E	E	E	E
30	322	E	334	324	324	228	E	E	E	E
31	239	E	249	241	241	194	E	E	E	E
32	502	E	503	503	503	502	E	E	E	E
33	330	E	344	333	333	248	E	E	E	E
34	221	E	228	222	222	168	E	E	E	E
35	136	E	141	137	137	121	E	E	E	E
36	205	E	218	207	207	163	E	E	E	E
37	139	E	150	141	141	123	E	E	E	E

Table 3.1.3C (Continued) Cumulative effects analysis for water quality and associated beneficial uses for period 1

38	157	E	165	160	160	131	E	E	E	E
39	273	E	287	276	276	193	E	E	E	E
40	173	E	178	173	173	148	E	E	E	E
41	218	E	221	219	219	219	E	E	E	E
42	252	E	261	254	254	183	E	E	E	E
43	84	E	84	84	84	84	E	E	E	E
44	169	E	175	169	169	143	E	E	E	E
45	354	E	366	355	355	309	E	E	E	E
46	85	E	86	86	86	86	E	E	E	E
47	187	E	195	188	188	166	E	E	E	E
48	117	E	123	118	118	104	E	E	E	E
49	146	E	152	148	148	136	E	E	E	E
50	212	E	224	214	214	160	E	E	E	E
51	142	E	152	144	144	129	E	E	E	E
52	149	E	155	151	151	127	E	E	E	E
53	513	E	517	516	516	497	E	E	E	E
54	362	E	366	363	363	308	E	E	E	E
55	832	A	837	837	837	837	A	A	A	A
56	383	E	388	388	388	388	E	E	E	E
57	135	E	139	136	136	111	E	E	E	E
58	153	E	161	155	155	147	E	E	E	E
59	850	A	854	851	851	851	A	A	A	A
60	871	A	872	871	871	73	A	A	A	E
61	68	E	68	68	68	68	E	E	E	E
62	100	E	101	101	100	100	E	E	E	E
63	235	E	241	236	236	192	E	E	E	E
64	395	E	402	396	396	354	E	E	E	E
65	138	E	144	139	139	134	E	E	E	E
66	147	E	154	149	149	115	E	E	E	E
67	54	E	59	55	55	55	E	E	E	E
68	275	E	284	276	276	245	E	E	E	E
69	211	E	213	212	212	211	E	E	E	E
70	69	E	72	69	69	68	E	E	E	E
71	57	E	57	57	57	57	E	E	E	E
72	823	A	826	823	823	820	A	A	A	A
73	100	E	104	101	101	99	E	E	E	E
74	72	E	75	73	73	69	E	E	E	E
75	89	E	89	89	89	89	E	E	E	E
76	491	E	495	492	492	443	E	E	E	E
77	101	E	106	102	102	83	E	E	E	E
78	145	E	149	146	146	145	E	E	E	E
79	216	E	217	217	217	215	E	E	E	E
80	132	E	132	132	132	132	E	E	E	E

[1] E=Excellent, A=Average, BA=Below Average;

These results are visually displayed in maps in the Appendix B.13 of this document.

Discussion of Results

Of the 80 watersheds modeled across LBL, 72 are in excellent watershed condition and remain so through the first decade's proposed management activities. Seven watersheds are average in WCR and one is below average WCR. It should be noted that mitigations are not modeled, and recovery from past activities is not recognized. This is left for project-level analysis when site specific data is available.

Watersheds rated average include several small basins surrounding main facilities of LBL: Hillman-Ferry Campground, Pisgah Point, Elk-Bison Prairie, Energy Lake Campground, and Day Use Areas. Road and trail densities in these areas are the driving force of high erosional rates. Because no change is forecast in these popular use sites, the WCR remains the same for all alternatives.

WCR's of average indicate more site specific analysis is needed for any change in management or activity level within these watersheds. Project level analysis should identify sediment sources and recommend improvement of practices and rehabilitation needs. Crooked Creek which drains Elk Bison Prairie into Energy Lake should be monitored for support of aquatic biota during project level analysis. Streams draining the other areas have ephemeral and intermittent flows and support limited aquatic biota. Turkey Bay is monitored by Hancock Biological Station under administration of Murray State University for sediment and aquatic biota. Data collected to date has shown no difference in biota levels than other embayments along LBL's shore of Kentucky Lake (personal communication, Steven White, Thomas Kind, Murray State University). .

Watershed Number 55 on the southern end of LBL is primarily under private ownership. This watershed is rated average in the WCR, as a result of road density and agricultural practices. Any activities within LBL would not influence the WCR of Watershed Number 55. Two other small drainages rated average. These watersheds drain the north fork of Turkey Creek and the interfluvial catchment to Turkey Bay. Facilities in these areas include portions of Turkey Bay OHV Area and Golden Pond administrative sites.

Only one watershed (Turner Hollow) rated below average. Turkey Bay OHV area overlies 98 percent of this small basin. Conditions under Alternatives W, X, and Y remain the same as current (below average) for the first decade and through all periods modeled. Limiting use at Turkey Bay OHV to designated trails while eliminating cross country use improve conditions throughout all alternatives. Designating trails will cause the closure and rehabilitation of some existing user made trails and various sections of trails that are not located on desired areas of the landscape. Further, designating trail routes within Turkey Bay will also reduce stream sedimentation and erosion on steep slopes and allows for improvements and proper design of trails at creek crossings.

Although water bodies of LBL have not been listed by Kentucky and Tennessee Division of Water (DOW) as impaired, local assessments of the Turkey Bay OHV area have concluded that additional improvements are needed for resource protection. Since Turkey Creek (Turner Hollow) has been identified in the Area Plan as one of three priority watersheds to be improved, an assessment of this area will be conducted at the project level. During project planning, site specific data should be collected and analyzed to seek methods to improve watershed health and determine support level of aquatic biota (if any) within the perennial and intermittent streams. Rehabilitation activities to date and other mitigations need to be considered at project level analysis.

3.2 Biological Environment

3.2.1 Introduction and Analysis Methods

The National Forest Management Act (NFMA), which initiated the requirement to prepare land and resource management plans, states that such plans must "provide for diversity of plant and animal communities based on the suitability and capability of the specific land area in order to meet overall multiple-use objectives…" Implementing regulations require that habitat be managed to support viable populations of native and desirable non-native vertebrates within the planning area (36 CFR 219.19). USDA Regulation 9500-004, expanded the NFMA viability regulation by requiring that habitats on national forests be managed to support viable populations of native and desired non-native "plants, fish, and wildlife."

To meet these requirements, a comprehensive approach was developed to identify and consider key ecological components on LBL (Figure 3.2.1A). Terrestrial ecological conditions were defined and mapped in terms of five ecological *Site Types,* nine major community *Cover Typ*es, and seven vegetation *Structure Types.* In addition, seven rare communities, 101 species of viability concern, and 26 species groups based on habitat associations were also identified. All of these ecological components are described in detail in the following sections. Aquatic ecological conditions were defined and analyzed in relation to 80 watersheds as described in Section 3.1.3.

A framework for assessing status of ecological components was developed by modifying an approach used by The Nature Conservancy for conservation planning. From the lists of ecological components identified for LBL, a subset were selected as "Conservation Targets," or those elements deemed important for planning to address in order to provide for diversity of plant and animal communities. Conservation Targets included all major community cover types, all rare communities, all habitat association groups, and selected species with needs deemed not sufficiently covered by provisions for communities and habitat association groups. For each Conservation Target, "Key Factors," were identified. Key Factors are those factors most critical for limiting ecological function and viability of associated species. Measurable "Indicators" were then identified for each Key Factor. "Threshold" levels were set for each indicator to represent poor, fair, good, and very good conditions.

To provide a benchmark for helping set thresholds for some indicators, an optimal mix of ecological conditions was defined by agency biologists in terms of the Site Types, Cover Types, and Structure Types. These conditions then became the benchmark by which the thresholds for the indicator species were established, and are identified throughout this section as the *optimal* condition.

Optimal in this context refers to the mix of ecological conditions that agency biologists, in consultation with local experts from universities and partner agencies and organizations, believe best reflects the natural diversity of native plant and animal communities and best supports the viability of associated species. It is designed to serve as a benchmark for developing and assessing alternatives. It is not intended to be, nor should it be viewed as, an overall desired condition for LBL, because it does not incorporate all of the multiple-use and logistical issues that must be considered as part of the planning process. This optimal mix of conditions was compared to current conditions (Appendix E, Table E.2) to identify which conditions are in relatively short supply and could be the target of management objectives. Thresholds are set and effects of alternatives are analyzed in terms of how well future conditions approach these optimal benchmarks.

Setting this "optimal" benchmark is necessary to answer the question "How much is enough?" relative to each different ecological condition. This question is one of the most critical and difficult ones to be answered during conservation planning. Setting ecological benchmarks may be done using a variety of methods; including use of historical reference conditions (Groves, 2003). Agency biologists defined optimal conditions in this case by relying primarily on general knowledge of conditions from the historical reference period of 1400 to 1780 (Chester and Fralish, 2002), which represents conditions just prior to major ecological changes brought by European settlement of the region. The assumption is that these reference conditions represent those to which native species are best adapted, and therefore would best provide for their viability. Because information on these reference conditions is spotty and not well documented, expert judgment is needed and precision is not high. Some benchmark levels have been modified from those in the Draft EIS based on review and input sought from scientists familiar with the ecology of the region.

Unless compelling evidence or rationale was available, Thresholds for Indicators were defined mechanically based on a percentage of optimal benchmark level (Table 3.2.1A). Higher percentages of the optimal benchmark were used to set thresholds for indicators that would be rare even under optimal conditions; lower percentages were used for indicators that would be common under optimal conditions. This approach is based on the assumption that, in general, more common conditions are less likely to be critically limiting to viability of associated species than would rarer conditions.

Indicators and thresholds have not been developed for all conservation targets. Some conservation targets and key factors are better addressed through plan standards that clearly indicate acceptable conditions or practices.

Expected acreage of selected ecological conditions were calculated for each alternative at 10- and 50-year time periods. These acreages were calculated by applying management activities to current acreage in ways that moved mixes of conditions toward the "optimal" benchmark. Attaining "optimal" benchmark conditions was constrained by expected levels of funding and organizational resources, and other multiple-use considerations consistent with the emphasis of each alternative. Expected acreage outcomes for each alternative were then assessed for each Key Factor by comparing them to Indicator Thresholds. In general, outcomes in the "good" and "very good" ranges are assumed to provide low risk to diversity and species viability; outcomes in the "fair" and "poor" ranges are of potential concern.

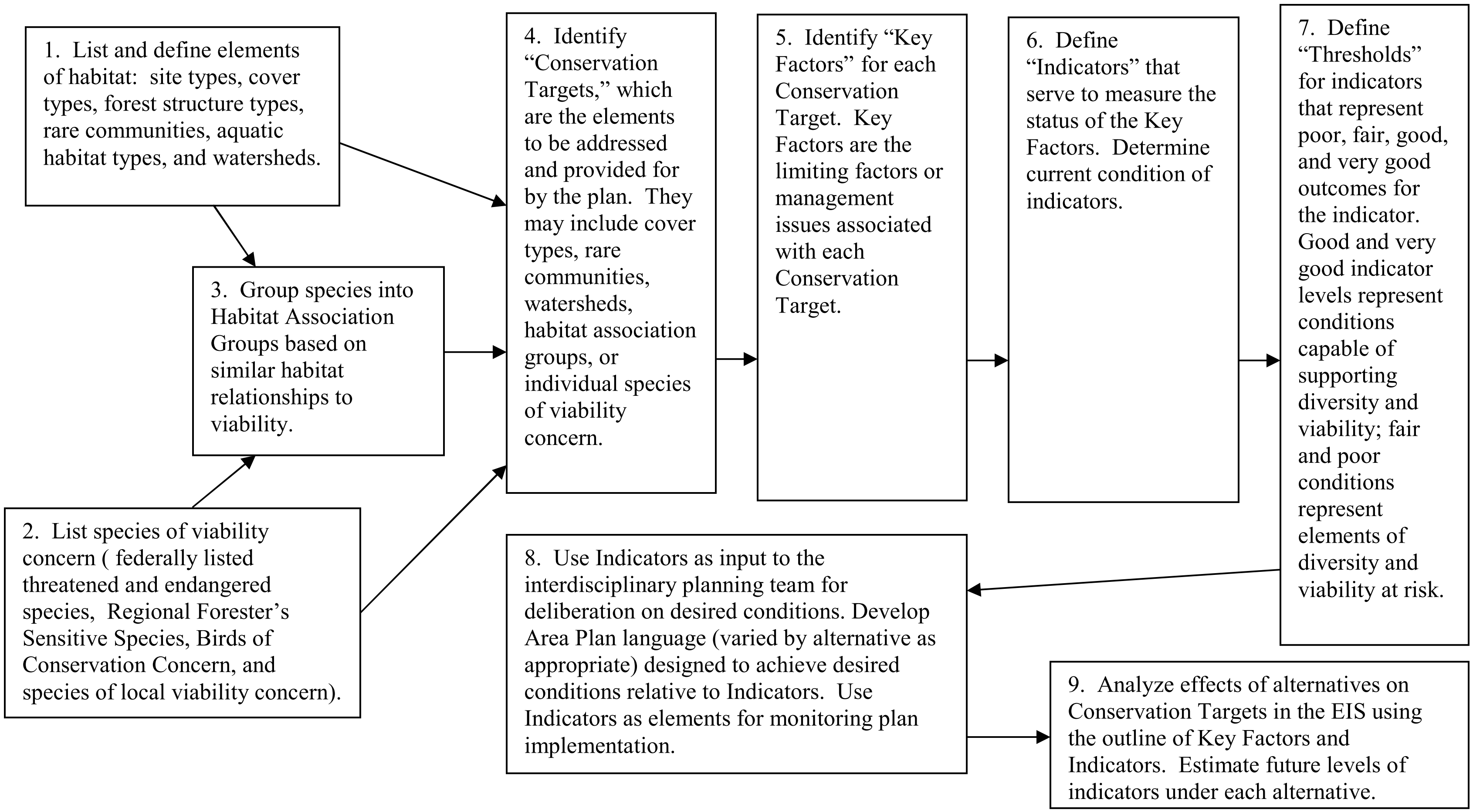
Analysis of landscape-level mixes of ecological conditions is designed to ensure that conditions are generally suitable for sustaining whole communities and viability of associated species within the constraints of land capability and agency mandates. However, a closer look at individual species of viability concern is necessary to ensure these broader scale provisions adequately provide for their needs. This closer look began by grouping these species into Habitat Associations based on their habitat relationships. Habitat Associations are defined primarily in terms of combinations of Site Types, Cover Types, Structure Types, or Rare Communities. Additional Habitat Associations are defined on the basis of specific habitat components (e.g., snags) or aquatic systems. Habitat availability for these groups under each alternative is compared to "optimal" conditions to identify where habitat may be most limiting to these species. Finally, each species of viability concern is given a final review, using the preceding analysis and considering species-specific needs. Where necessary, plan provisions and environmental analysis are focused on individual species of concern.

In addition to requirements relative to species viability, National Forest Management Act regulations require selection of management indicator species as part of the planning process to help indicate the effects of management on fish and wildlife resources (36 CFR 219.19). Where appropriate, management indicator species have been selected and are analyzed in the following sections according to the purpose for which they were selected. The full list of management indicator species and reasons for their selection are found in Appendix F.

Table 3.2.1A - Percentage of **"optimal" benchmark** conditions used to calculate thresholds for categorizing poor, fair, good, and very good conditions. Percentages vary by relative abundance (% of LBL acreage) of the condition at an optimal state.

	Percent of Optimal			
Percent of LBL occupied under optimal conditions	**Very Good is >**	**Good is >**	**Fair is >**	**Poor is <**
> 10%	75%	50%	25%	25%
1% to 10%	85%	60%	35%	35%
< 1%	95%	70%	45%	45%

Figure 3.2.1a. Process used during plan development for Land Between The Lakes National Recreation Area to provide for a diversity of plant and animal communities and viability of associated plants, fish, and wildlife, 2004.



3.2.2 Historical Perspective

Knowledge of historical ecological conditions is important because approximating some of these conditions through maintenance or restoration activities may be necessary to sustain populations of some native plants and animals. While complete re-creation of historical conditions is not feasible, and in many cases not socially desirable, knowledge of such conditions can provide one type of template or benchmark for assessing effects of management on native communities. Historical conditions of most interest are those of the period directly preceding European contact and settlement, because these conditions presumably are those to which most native plants and animals are best adapted. This focus is not meant to imply that ecological conditions during this period were not impacted by humans or necessarily highly stable. Evidence indicates that American Indians influenced their environment in extensive and important ways. However, in comparison, these influences were less severe and more stable over a longer period than those that followed European settlement, allowing a higher degree of adaptation by native plants and animals.

The forest resources of LBL have been affected by humans for many centuries, beginning with prehistoric hunters who burned areas to flush game. This also created changes in habitat conditions for wildlife and fruit bearing shrubs which provided important food sources. From the early 1800s until TVA's management began in 1964, the forest resources of LBL were generally heavily exploited. The iron industry years were followed by demand for railroad ties and mine timbers. In addition to human activity, tree disease, drought, wind throw, and wildfire have had significant impacts on forest composition. The American chestnut blight is an example of a devastating tree disease. As elsewhere in the Eastern United States, this once dominant forest canopy tree disappeared from the LBL area in the early to mid-1900s (TVA NRMP 1994).

Historically, about 400,000 hectares of grasslands and open woodlands were part of the vegetation mosaic of Kentucky in pre-settlement times, particularly in the western part of the state. Early settlers and travelers called the region "the barrens" referring to extensive meadows without trees. With immediate suppression of fire and extensive cultivation this vegetation type virtually disappeared. In this century, these grasslands have been viewed as a successional, temporary type maintained by fires set by American Indians. Recent reviews of the historical references to the "Big Barrens" of Kentucky and Tennessee provided climatic, paleo-vegetation, floristic, and faunistic evidence that these barrens originated with and were maintained by Indians in the last 3000-4000 years, not as a vegetation type that established during a dry interval at the beginning of the Holocene, about 20,000 years ago (Martin and Taylor, 2002).

In the historic "Barrens region", floristic elements of this vegetation type still exist in abandoned cultivated fields and pastures, along highway rights-of-way, and in areas with shallow soils. In particular, abandoned cultivated fields and pastures are often dominated by grasses such as little bluestem (*Schizachyrium scoparium*), and Indiangrass (*Sorghastrum nutans*), in addition to old-field grasses such as broomsedge (*Andropogon virginicus*). Along drainages, in ditches, and on more mesic sites, the dominants can be big bluestem (*Andropogon gerardi*), switchgrass (*Panicum virgatum*), and eastern gamma grass (*Tripsacum dactyloides*) in order of increasingly wetter sites (Martin and Taylor, 2002).

Perhaps the most profound ecological disturbance of all occurred with the introduction to North America and spread of *Cryphonectria parasitica*, the exotic fungus that causes chestnut blight. While it causes only minor direct effects on a few oak species, it has caused unequaled impacts on oak forests that are still manifest today. American chestnut (*Castanea detata*) was the most important hardwood tree in the Southern Appalachian forests (Oak, 2002) and to a much lesser extent, LBL based on the historic range of this species (Schlarbaum *et. al.,* 1997) and 1789-1818 land surveys in LBL (DeSelm, 1999).

Originating in Asia, the chestnut blight pathogen was first detected in the Bronx, New York in 1904. The pathogen spread rapidly, since native chestnuts lacked co-evolved disease resistance. By 1940, chestnut blight had killed 50-99 percent of the American chestnuts throughout its botanical range. The tree persists today as sprout growth from residual root systems, but usually attains diameters of only a few centimeters and rarely flowers before succumbing again. As chestnuts died, newly available growing space was quickly occupied by other species already positioned in the mid- and understory by earlier disturbances such as repeated fire and logging. Chestnut replacement was variable, but typically oak species (*Quercus prinus* L., *Q. rubra* L. and *Q. velutina* Lam.) in particular increased (Oak, 2002).

When Europeans began exploring LBL and surrounding areas cultures 300 years before present, they found bottomland hardwoods of enormous size and upland park-like forests with an herbaceous understory. Europeans began settling the area in the late 1700s. Their influence on the vegetation included farming, grazing, whiskey distilling, timber cutting for charcoal production, railroad ties, and other wood products, and impounding of the Cumberland (1964) and Tennessee (1945) rivers. Aside from the damming that eliminated the bottomland forests, the charcoal industry that peaked in the mid-1800s may have had the greatest impact on the LBL landscape. Iron ore manufacturing required large amounts of limestone (mined in the vicinity), iron ore, (mined in the vicinity from the cretaceous gravel), and charcoal (created from the felling of large acreages of timber). There were eight iron furnaces in blast in LBL, and each left its mark on the landscape. Very few forest trees in LBL can boast ages of greater than 150 years. The onset of European occupation included widespread clearing of land for agriculture and the suppression of fire, mainly to protect the timber. In the end, agro-deforestation (turning forest into field) and wildland fire led to the reduction of forest dominance across the landscape. Bottomland forests were converted to agricultural land and were later inundated by Kentucky Lake and Lake Barkley (Franklin, 1994 and Franklin *et. al.,* 2002).

The decline of the red oak group has led to a loss of these species in both stable and successional forest communities in LBL forest wide. This decline is not unique to LBL.

During the early 1980s, high mortality rates were experienced across the central hardwood region due to a severe episode of oak decline. Red oak species in particular are a key contributor to the consistent long-term production of mast, utilized as food by many species of wildlife. The decline and subsequent mortality of red oak species can affect wildlife population levels, vegetative diversity, abundance, and richness. However, red oak snags and downed logs also serve as important structural components of the forest for various wildlife species. Annual mortality and decomposition rates affect accumulation of snags and downed logs. Snags and downed logs are considered to be common forest wide, even though data is not currently available for LBL (TVA NRMP 1994).

According to TVA 1994 NRMP FEIS, the maple of the maple-beech forest cover type is increasing more than the beech in the forest understory and mid-story on approximately 30 percent of LBL's forest. The maple-beech cover type is dominant as an overstory component of approximately five percent of the forest. The southern half of LBL contains the largest portion of the 35 percent maple/beech component and the northern half has a patchy distribution. In stands below an elevation of 460 feet (excluding Saffell soils, some ridges, and the upper slopes of south and west aspects), succession to maple, especially of the maple-beech forest type, with white oak as a minor associated species, is occurring and many stands are already dominated by these species. Estimates are that 40 to 50 percent of LBL's forest has the potential to gradually (100 to 300 years) convert to this cover type in the absence of disturbance. Studies of central hardwood forests throughout the LBL region and the LBL forest, point to a tendency for the present predominantly red and white oak forests on mesic sites to succeed to maple-beech, unless significant disturbance occurs. Significant disturbance includes timber harvest, TSI, fire, insects, disease, and weather-related events. Maple-beech dominated stands contribute to the richness of LBL's predominantly oak-hickory forest, and enhance fall colors at LBL which many visitors enjoy. However, the continuing development of maple-beech in all canopy layers of the forest will cause shifts over the long term in the species composition of the herbaceous layer and the shrub layer. Such shifts will also prevent oak seedling establishment and growth due to resulting heavy shade (TVA NRMP 1994).

3.2.3 Major Forest Communities

Affected Environment

Site Types

To determine the ecological potential for vegetation cover types within LBL the landscape was stratified by ecological site types. Within LBL, 118 soil types were combined with data on elevation, slope, and aspect to define five Site Types: Xeric, Dry, Dry-Mesic, Mesic, and Alluvial (Appendix E). These site types are based primarily on soil moisture conditions and elevation. The geology of LBL and characteristics for 10 major soil types are discussed and defined in Section 3.1.2.

Xeric site type - Representative of extremely dry soil conditions. Soils for this site type are located at an elevation >460 ft. and have mostly flat and SE-NW aspects on 0-12 percent and some 12-60 percent slopes. Soils associated with this site type may be characterized by one or more of the following elements: fragipan; gravely or cherty surface; thin soil surface cover; extremely acidic soil and low fertility; droughty soil conditions most of the year; and associated vegetation and growth is representative of relatively poor soil conditions.

Dry site type - Representative of soils with conditions which are very limited or devoid of moisture. Soils for this site type are located at an elevation >460 ft. and are primarily representative of all the aspects on 0 to 60 percent slopes. Soils associated with this site type are characterized by one or more of the following elements: acidic to moderately acidic soil and low to moderate fertility; and vegetation and growth representative of relatively poor to moderate soil conditions.

Dry-mesic site type - Representative of a vegetation transition zone on the landscape in which both dry and mesic soil conditions occur. Soils for this site type are located at an elevation <460 ft. (Close *et. al*., 2002) and are primarily representative of all the aspects that range in 0 to 50 percent slopes. Soils associated with this site type are those that support vegetation that occurs on dry and mesic site types.

Mesic site type - Representative of moist soil conditions. Soils associated with this site type are stream terraces (derived from alluvium and colluvium), coves, and foot-slopes located at elevations > and < 460 ft. and are representative of all aspects on 0-6 percent slopes.

Alluvial site type - Pertains to and generally representative of the bank of a river, lake, or other body of water, wetness for a period of time. Soils associated with this site type are those created from or in alluvium that includes floodplains, wetlands, river bottoms, some streams, and depressions. These soils are represented at elevations > and < 460 ft. for all aspects on zero to three percent slopes.

Analysis indicates 41 of LBL is comprised of dry-mesic sites, with 47 percent dry and xeric sites, and the remaining 12 percent representing mesic and alluvial sites (Table 3.2.3A).

Table 3.2.3A - Site type acres in Land Between The Lakes

	SITE TYPE					
	Xeric	Dry	Dry-Mesic	Mesic	Alluvial	Total
Acres	3,357	76,793	69,286	8,988	12,830	171,254
Percent	2.0%	44.8%	40.5%	5.2%	7.5%	100.0%

Major Cover Types

Cover Types, or vegetation community types, are the basic building blocks for assessing community diversity on a landscape. Nine cover types were defined and mapped using a combination of GIS data from Kentucky GAP Analysis, remote sensing satellite imagery, and TVA databases (see Appendix E, Cover Type Map). Cover Types are: Oak Forest, Mesophytic Forest, Riparian Forest, Shortleaf Pine Forest, Planted Pine Forest, Grassland, Cultivated Lands, Water, and Administrative Areas.

Oak Forests are forests dominated by mixed oak species. For some analysis purposes, this cover type was divided into two groups based on the site types on which they occur and the related composition of understory regeneration in the absence of ecological disturbance.

- **Oak Forests on Xeric and Dry Sites** generally support a predominance of oak regeneration in the understory without the presence of fire or other disturbance factors, indicating that oak will replace itself and remain the dominant tree species over time without management intervention. Tree species associated with this forest type include: white oak, southern red oak, post oak, blackjack oak, chestnut oak, and pignut hickory (GIS Data, Appendix B.2; KDFWR-GAP 2003). This type includes the Chestnut Oak *(Quercus prinus)* and Post Oak Communities *(Quercus stellata),* and in part the White Oak *(Quercus alba)* and Black Oak *(Quercus velutina)* Communities of Fralish and Crooks (1989). It also includes the compositionally-stable Chestnut Oak, Post Oak, Mixed Oak, and White Oak Communities of Franklin *et al*. (2002).

- **Oak Forest on Dry-Mesic, Mesic, and Alluvial Sites** generally support sugar maple and American beech regeneration in the understory. In the absence of some disturbance factor such as fire, grazing, or vegetation management, these shade tolerant species will eventually become dominant in the stand as overstory oaks die. This type includes, in part, the White Oak *(Quercus alba)* and Black Oak *(Quercus velutina)* Communities of Fralish and Crooks (1989) and the successional Mixed Oak, Chestnut Oak, Black Oak, and White Oak Communities of Franklin *et al*. (2002). All Oak Forests on LBL are a subset of the South-Central Interior Highlands Dry Oak Forest (CES202.898) of NatureServe's Ecological Systems classification (NatureServe, 2003).

Mesophytic Forests generally occur on dry-mesic, mesic, and alluvial sites and are dominated by sugar maple and American beech with up to 23 associated tree species, including white oak, mockernut hickory, pignut hickory, sweetgum, yellow poplar, and elm (Fralish and Crooks 1988 and 1989). This type includes the American beech *(Fagus grandifolia,* -Sugar maple *(Acer saccharum),* and *Acer saccharum*-Mesophytic Communities of Fralish and Crooks (1989), and the American Beech, Mixed Mesophytes, and Sugar Maple Communities of Franklin *et. al.* (2002). This forest type falls within the CES202.887 South-Central Interior Mesophytic Forest Ecological System of NatureServe (2003).

Riparian Forests primarily occur on alluvial sites and mesic sites. This forest type is dominated by riparian associated species such as sweetgum, elm, box-elder, red maple, yellow poplar, sycamore, birch, and black willow, or dominated by sugar maple with a significant component of these other riparian species (KDFWR-GAP, 2003; NatureServe, 2003). They are typically found adjacent to rivers or large streams on levees or floodplains. This type includes four types of bottomland hardwood forests described by Fralish and Crooks (1988 and 1989): box-elder forest, sweetgum/cherrybark oak forest, sycamore/birch forest, and overcup/swamp chestnut oak forest. This type is a subset of the CES202.706 South-Central Interior Small Stream and Riparian Ecological System of NatureServe (2003).

Shortleaf Pine Forest is dominated by naturally regenerated shortleaf pine, but may include a significant component of oak. It includes the Shortleaf Pine *(Pinus echinata)* Community of Fralish and Crooks (1989), and the successional Shortleaf Pine Community of Franklin *et al*. (2002). It falls within the CES202.332 Southern Appalachian Low Mountain Pine Forest Ecological System of NatureServe (2003).

On LBL, this native shortleaf pine community is limited to a small area located within a registered Core Area and a registered State of Tennessee Natural Area. Franklin and Kupfer (2000) studied and reported on 10 years of change and the current classification of vegetation of this community type within about a 1,100 acre area. They noted that the pine component has decreased and the shortleaf pine forest is converting to oak dominance. Reasons for succession to oak appear to be suppression of fire during this century (Franklin and Kupfer, 2000). These authors also indicate that shortleaf pine depends on the exposure of mineral soil and high light levels, conditions provided by periodic fire. Franklin and Kupfer (2000) suggest that the area surrounding and including the native shortleaf pine be thinned and burned to expand the current pine population.

Planted Pine Forest is comprised of relatively small patches of pine historically planted across LBL to provide vegetation diversity and thermal cover for wildlife. Loblolly pine is most common, but some patches of Virginia pine, eastern white pine, and bald cypress also occur.

Grassland includes all open lands maintained in a grass/forb condition through periodic maintenance. It includes areas restored and maintained as native grasslands, hayfields, old fields, and road and utility rights-of-way. A variety of conditions exist within this type, with quality as wildlife habitat varying widely. Most is currently dominated by nonnative grasses, which do not create the vegetation structure preferred by many native species.

Cultivated Land includes open lands cultivated for crops through the co-op program, as well as areas maintained and planted solely for the benefit of wildlife. The latter areas are generally smaller than cropland fields, and are maintained by Forest Service staff.

Water includes lakes, ponds, and associated wetland areas.

Administrative Areas include all areas modified by developed facilities to the extent that ecological community and habitat values are clearly subordinate to human uses. It includes buildings and associated lawns, developed campgrounds, major roads, and high use portions of the OHV areas and trail heads.

LBL is currently dominated by Oak Forest (82.2 percent), which occurs across a wide range of site types (Table 3.2.3B). Mesophytic and Riparian Forests occupy a relatively small proportion of LBL (3.8 percent and 3.2 percent, respectively), and are likely greatly reduced on the landscape due to the impoundment of Kentucky Lake and Lake Barkley, which flooded prime sites for these forest types. Other cover types, including the open land types (grassland and cultivated lands), represent much smaller proportions of the LBL landscape, but provide important elements of community diversity. Grasslands dominated by native grasses are currently being restored through active management on approximately 600 acres, representing nine percent of grassland acres, and less than 0.4 percent of total acres on LBL.

Table 3.2.3B. - Current acres of cover types by site type on Land Between The Lakes.

	ACRES BY SITE TYPE						
COVER TYPE	**Xeric**	**Dry**	**Dry-Mesic**	**Mesic**	**Alluvial**	**Total**	**% of Total**
Oak Forest	2,784	70,543	58,350	5,762	3,359	**140,798**	82.2%
Mesophytic Forest	0	526	4,310	764	981	**6,580**	3.8%
Riparian Forest	0	13	955	494	4,054	**5,515**	3.2%
Shortleaf Pine Forest	7	82	36	5	0	**130**	0.1%
Planted Pine Forest	173	1,848	1,646	272	297	**4,236**	2.5%
Grasslands	264	2,312	2,205	576	1,165	**6,522**	3.8%
Cultivated Lands	37	439	849	989	1,811	**4,124**	2.4%
Water	2	8	21	3	917	**952**	0.6%
Administrative Areas	89	1,022	915	125	245	**2,396**	1.4%
Total	**3,357**	**76,793**	**69,286**	**8,988**	**12,830**	**171,254**	**100.0%**

Structure Types

Plant and animal diversity within a given forest cover type is greatly dependent on the structural condition of the community. Seven general forest structure types were defined: Mature Closed Canopy Forest, Mature Open Canopy Forest, Mature Woodland, Mature Forest with Canopy Gaps, Mid-aged Forest, Young Forest, and Regenerating Forest.

For simplicity and ease of inventory and analysis, the minimum age for all mature forest type definitions is 60 years. Some commenters on the Draft EIS felt like this was too young to represent truly mature stands. In the Final EIS, this parameter is retained, following Helms (1998), who defines mature forests as a stand "that is capable of sexual reproduction…, has attained most of its potential height growth, or has reached merchantability standards…". While this definition in some ways reflects a timber management orientation, it is also relevant to important habitat components such as mast production, tree size, and structure. For oak forests, the dominant forest type on LBL, sixty years is deemed the beginning of peak acorn production and habitat suitability for many wildlife species associated with mature forest. At the same time, it is recognized that these forests do not provide all of the structural characteristics (snags, downed wood, canopy gaps) needed or preferred by some wildlife species. For this reason, “old growth” is recognized as a subset of mature forest types and optimal benchmarks for it has been set. Criteria for old growth, including minimum ages by forest type, are discussed at the end of Section 3.2.4, along with estimated effects of alternatives on old growth abundance.

Structure Type definitions are:

- **Mature Closed Forest** are forests with canopy trees averaging greater than 60 years old, with less than 80 percent of the understory or forest floor receiving direct sunlight.

- **Mature Open Forest** is a forest with canopy trees averaging greater than 60 years old with 60 to 80 percent of the understory or forest floor receiving direct sunlight.

- **Mature Woodland** are very open forests with canopy trees averaging greater than 60 years old and 10 to 60 percent of the understory or forest floor receiving direct sunlight. Understories are dominated by grasses and forbs.

- **Mature Forest with Canopy Gaps** are forests with canopy trees averaging greater than 60 years old, with a very heterogeneous canopy. Canopy gaps of 0.25 to 2.0 acres occupy approximately five to 40 percent of the stand area. Patches of regenerating forest typically occupy gaps. This structure type is distinguished from Mature Open Forest by the heterogeneity of canopy coverage. In general, Mature Open Forest is more typical of drier sites, while this structural type is more typical of more mesic sites. It is thought to represent typical structure of old growth forests, especially on mesic sites.

- **Mid-aged Forests** are characterized by mid-sized trees, typically with complete canopy closure and undergoing significant reduction in stem densities due to competitive exclusion. Age of canopy trees generally will average between 30 and 60 years, and diameter generally will average five to 11 inches. Scattered larger and older trees may be present (less than 60 percent canopy-cover).

- **Young Forests** are forests with a closed canopy and high density of developing saplings that have not yet reached five inches in diameter. These forests will generally be 10 to 30 years of age. Scattered large older trees may be present if less than 60 percent canopy cover.

- **Regenerating Forests** are dominated by trees less than 10 years old, generally at densities exceeding 100 developing tree seedlings per acre and overstories of older trees providing less than 60 percent canopy closure.

Kentucky GAP Analysis was combined with the LBL Vegetation Age Class data to map these forest structure types across LBL (see Appendix E, Structure Type Map). These data were combined with cover type data to determine acres of each forest type in each structural condition by site type (Tables 3.2.3C thru 3.2.3H).

Table 3.2.3C - Structure Types of **Oak Forest** on Xeric and Dry Site Types

	Acres by Site Type					
Structure Type	**Xeric**	**Dry**	**Dry-Mesic**	**Mesic**	**Alluvial**	**Total Acres**
Mature Closed	26	43,591				43,618
Mature Open	2,186	7,874				10,059
Mature Woodland	0	0				0
Mature with Gaps	0	55				55
Mid-aged	110	7,568				7,678
Young	435	10,286				10,721
Regenerating	28	1,168				1,196
Total	**2,784**	**70,543**				73,327

Table 3.2.3D - Structure Type of **Oak Forest** on Dry-Mesic, Mesic, and Alluvial Site Types

	Acres by Site Type					
Structure Type	**Xeric**	**Dry**	**Dry-Mesic**	**Mesic**	**Alluvial**	**Total Acres**
Mature Closed			35,936	3,457	1,484	**40,878**
Mature Open			5,131	511	146	**5,787**
Mature Woodland			0	0	0	**0**
Mature with Gaps			63	0	1	**65**
Mid-aged			5,387	383	306	**6,076**
Young			10,726	1,302	1,389	**13,417**
Regenerating			1,107	109	33	**1,249**
Total			**58,350**	**5,762**	**3,359**	**67,471**

Table 3.2.3E - Structure Type of **Mesophytic Forest** by Site Type						
	Acres by Site Type					
Structure Type	**Xeric**	**Dry**	**Dry-Mesic**	**Mesic**	**Alluvial**	**Total Acres**
Mature Closed	0	367	2835	349	229	**3,781**
Mature Open	0	42	218	31	14	**306**
Mature Woodland	0	0	0	0	0	**0**
Mature with Gaps	0	0	0	0	0	**0**
Mid-aged	0	41	311	29	77	**458**
Young	0	66	897	350	658	**1,971**
Regenerating	0	9	48	5	2	**65**
Total	**0**	**526**	**4,310**	**764**	**981**	**6,580**

Table 3.2.3F - Structure Type of **Riparian Forest** by Site Type						
	Acres by Site Type					
Structure Type	**Xeric**	**Dry**	**Dry-Mesic**	**Mesic**	**Alluvial**	**Total Acres**
Mature Closed	0	4	514	166	1229	**1913**
Mature Open	0	1	47	3	47	**97**
Mature Woodland	0	0	0	0	0	**0**
Mature with Gaps	0	0	0	0	0	**0**
Mid-aged	0	3	108	44	449	**604**
Young	0	5	282	280	2308	**2875**
Regenerating	0	0	4	0	22	**26**
Total	**0**	**13**	**955**	**494**	**4054**	**5515**

Table 3.2.3G - Structure Type of **Shortleaf Pine Forest** by Site Type						
	Acres by Site Type					
Structure Type	**Xeric**	**Dry**	**Dry-Mesic**	**Mesic**	**Alluvial**	**Total Acres**
Mature Closed	5	82	36	5	0	**128**
Mature Open	2	0	0	0	0	**2**
Mature Woodland	0	0	0	0	0	**0**
Mature with Gaps	0	0	0	0	0	**0**
Mid-aged	0	0	0	0	0	**1**
Young	0	0	0	0	0	**0**
Regenerating	0	0	0	0	0	**0**
Total	**7**	**82**	**36**	**5**	**0**	**130**

Table 3.2.3H- Structure Type of **Planted Pine Forest** by Site Type						
	Acres by Site Type					
Structure Type	**Xeric**	**Dry**	**Dry-Mesic**	**Mesic**	**Alluvial**	**Total Acres**
Mature Closed	9	435	316	78	42	**879**
Mature Open	30	27	24	2	3	**87**
Mature Woodland	0	0	0	0	0	**0**
Mature with Gaps	0	0	0	0	0	**0**
Mid-aged	91	967	779	60	124	**2020**
Young	42	365	450	118	95	**1070**
Regenerating	1	55	79	14	33	**181**
Total	**173**	**1848**	**1646**	**272**	**297**	**4236**

3.2.4 Environmental Effects

Mix of Cover Types

Management can change the mix of cover types on the LBL landscape by converting one type to another. For example, forests can be converted to grasslands, grasslands allowed to grow into forests, or cultivated lands converted to grasslands and ultimately to forests.

To determine where conversions between cover types may be desirable, a benchmark condition representing the "optimal" mix of cover types was developed by LBL biologists (Table 3.2.4A). "Optimal" in this context is that condition that, in the judgment of biologists, would best provide for native community diversity and the viability of associated species. Historical conditions prior to European settlement are used as a general template for defining this mix (see Section 3.2.1 for more detail on this process). Comparison of this benchmark condition with current condition helps identify where conversions may be desirable.

Table 3.2.4A - The percentages of cover types by site type representing an **"optimal"** benchmark for sustaining diversity of plant and animal communities and viability of associated species on LBL.

	Percent by Site Type					
COVER TYPE	**Xeric**	**Dry**	**Dry-Mesic**	**Mesic**	**Alluvial**	**Total**
Oak Forest	92.0%	93.0%	85.0%	25.0%	10.0%	**80.0%**
Mesophytic Forest	0.0%	0.0%	10.0%	70.0%	30.0%	**10.0%**
Riparian Forest	0.0%	0.0%	0.0%	0.0%	40.0%	**3.0%**
Shortleaf Pine – Oak Forest	3.0%	2.0%	0.0%	0.0%	0.0%	**1.0%**
Planted Pine Forest	0.0%	0.0%	0.0%	0.0%	0.0%	**0.0%**
Grasslands	5.0%	5.0%	5.0%	5.0%	5.0%	**5.0%**
Cultivated	0.0%	0.0%	0.0%	0.0%	0.0%	**0.0%**
Water	0.0%	0.0%	0.0%	0.0%	15.0%	**1.0%**
Administrative	0.0%	0.0%	0.0%	0.0%	0.0%	**0.0%**
Total	**100.0%**	**100.0%**	**100.0%**	**100.0%**	**100.0%**	**100.0%**

Some key factors considered when defining this benchmark condition are:

- Oak forests have been, and should remain, the dominant forest type on LBL, providing important wildlife food through acorn production and woody browse, and structure for dens and nests. Loss of chestnut to chestnut blight during the early 1900s may have reduced some mast and den tree capability, but chestnut restoration efforts cannot be counted on for the foreseeable future.

- Mesophytic and Riparian Forests are much reduced on today's landscape due to flooding of prime sites for these communities by lake impoundment. Although remaining mesic and riparian sites are not ideal for supporting Mesophytic and Riparian Forests because they historically represented mid-slope positions, development of these forest communities will occur on these sites in the absence of ecological disturbance. Some increase in acreage of these types is inevitable, and desirable for community diversity The optimal benchmark level for Mesophytic Forest on Dry-Mesic Sites was reduced between draft and final based on input from consulted scientists. This change reflects doubt that quality Mesophytic Forests can be restored on these transitional sites, and that in most cases Oak Forest is ecologically more appropriate.

- Shortleaf Pine Forest is native to the LBL landscape, but at the edge of its range. Therefore, it likely was not ever abundant, but more abundant than today due to succession to oak forest in the absence of fire. Acreage of Shortleaf Pine Forest may be increased by thinning the oak component stands with a shortleaf pine component and reintroducing fire to encourage pine regeneration. Analysis of sites and conditions surrounding the remaining patches of Shortleaf Pine Forest indicates a top potential of restoring this type to approximately 1300 to 1600 acres.

- Planted Pine Forest was not a component of historical landscapes, and therefore is not shown as a part of the benchmark condition. It does, however, add some diversity to the landscape without apparently impacting native community diversity; therefore, reducing its abundance is not viewed as a management need.

- American Indian use of fire helped create and maintain areas of Grassland especially on xeric and dry sites, where fire intensity was highest. Large grazers such as bison and elk also helped maintain grasslands. Although it is not possible to determine with precision the range of percent of the landscape in grassland during historical reference conditions, evidence indicates that it was higher than that, present today, due to recent effects of fire suppression. Distribution of grasslands across site types was likely skewed historically toward xeric and dry sites, as compared to today, where preference for creating fields on flatter fertile sites has skewed distribution of this type to more mesic sites (Table 3.2.3A). However, based on input from scientists during the review period for the Draft EIS, much of the dry and xeric grassland reflected in the draft benchmark has been added to oak forest type as mature woodland structure. General consensus of scientists consulted is that the woodland structure probably better reflects historical conditions on dry and xeric sites where fire was frequent.

- Although American Indians also cleared areas for cultivation, primarily on flat and fertile alluvial sites, the differences in American Indian cultivation methods and those practiced today are great enough that their effects on diversity are not highly comparable. For this reason, as discussed with scientists during draft review, the benchmark condition does not include cultivated lands. American Indian influence through cultivation is reflected in benchmark levels of grassland and canebrakes on mesic and alluvial sites.

- Although area in lakes is much increased today due to the large impoundments, small ponds and wetlands important to many native species are likely much reduced due to reduced activity of beaver and flooding of prime riparian sites where beaver ponds and wetlands would have been most abundant. The percent of water indicated for the benchmark condition represents desired amounts of quality wetlands and small ponds that would have been characteristic of historic conditions.

A comparison of the benchmark condition with current conditions reveals the following differences (see Appendix E, Table E.2) and potential management actions:

- Oak Forests are currently near the benchmark condition.
- Mesophytic Forests are currently less abundant than the benchmark condition and could be increased by reducing oak overstories in oak forests on dry-mesic, mesic, and alluvial sites. This type will increase on its own over long periods of time on these sites if some types of ecological disturbance or management actions are excluded. Core Areas provide portions of the landscape where this succession is most likely due to limited management activity.
- Riparian Forests are near the benchmark condition. Some increase in this forest type could be achieved by converting cultivated lands to forest on alluvial sites, especially within riparian corridors.
- Shortleaf Pine Forest is currently less abundant than the benchmark condition. This type could be increased by thinning and burning existing forest and converting oak forest with some pine component by thinning the oak and reintroducing fire.
- Grasslands are currently less abundant than the benchmark condition, especially on dry and dry-mesic sites. Grasslands on mesic and riparian sites slightly exceed benchmark conditions. Grasslands may be recreated on dry and xeric sites by clearing Oak Forest and reintroducing fire to these sites.
- Cultivated lands are currently more abundant than benchmark conditions.
- Water, not including Lake Barkley and Kentucky Lake, is slightly less abundant than benchmark conditions. Allowing beaver activity, to the extent compatible with facility protection and other resource uses, could increase acreage of quality wetlands.

Effects of alternatives on abundance of each cover type are discussed and disclosed in the following sections.

Mix of Structural Types within Forest Cover Types

Just as an “optimal” benchmark was set for the mix of cover types on the landscape, an “optimal” mix of structure types within each forest type was also defined. The following assumptions were used in defining these structural mixes.

- A uniform distribution of tree ages across all potential age classes is desirable for sustainable supplies of habitat and high levels of diversity.
- Because timber production is not a primary objective, “regulation” of tree ages is based on average maximum ages or average age at senescence of the dominant

canopy trees in each forest type (See Table 3.2.4B). These ages are taken from unpublished data of George Hopper, University of Tennessee.

- Sustainable reverse J curve size distributions with the largest sized trees represent the oldest potential age classes.
- Mature Closed and Mature Open under optimal conditions are even-aged or two-aged and acreages are uniformly distributed across 10 year age classes.
- For even- and two-aged forests, "old growth" is defined on the basis of minimum old growth ages (See Table 3.2.4B). Minimum old growth ages are from the R8 policy guidance on old growth (USDA Forest Service, 1997). Uneven-aged forest, under optimal conditions, are also viewed as "old growth," because they contain enough trees over minimum old growth age to qualify. Where it is an appropriate structural condition, mature woodland may also represent old growth once canopy trees reach minimum old growth age.

Table 3.2.4B - Average maximum age, average age at senescence, minimum "old growth" age, and percent of area occupied by each 10-year age class for forest communities in a landscape with balanced age-class distributions, Land Between The Lakes.

Forest Community	Oak on Xeric Sites	Oak on Dry Sites	Oak on Other Sites	Meso-phytic	Alluvial	Shortleaf Pine
Index Species	Chestnut oak	White oak	White oak	American Beech	Sweet-gum	Shortleaf Pine
Avg. Maximum Age	250	350	350	330	200	210
Avg. Age at Senescence	140	190	190	170	110	110
Min. Old Growth Age	90	120	120	140	100	100
Area per 10-yr Age-class at "Optimal" Benchmark	4.0%	2.9%	2.9%	3.0%	5.0%	4.8%
Percent Old Growth at "Optimal" Benchmark	64.0%	65.7%	65.7%	57.6%	50.0%	52.4%

Oak Forests

Factors considered in setting "optimal" benchmark condition for structure within Oak Forests (Table 3.2.4C) include:

- Oak trees are not highly shade tolerant and generally require relatively open forest conditions to develop levels of regeneration in the understory that are adequate to sustain their dominance on a site. Especially on more mesic sites, some moderate level of ecological disturbance, such as from periodic ground fires or grazing, is needed to maintain this open condition. Historically, such disturbances were present, resulting in the abundant oak forests we now enjoy; however, in recent times, fire suppression and removal of large grazers (elk and bison) have resulted in dense closed forests and concern about long-term oak maintenance. For these reasons, mature open forest structure is viewed as the desirable structural condition for most oak forests on the benchmark landscape.

- In the DEIS, mature closed oak forests and mature oak forests with canopy gaps (structural conditions generally indicative of lower levels of ecological disturbance) were not included as components of the benchmark landscape, because they are not optimal for providing oak regeneration and sustaining oak dominance on a site. However, based on input from scientists who reviewed the DEIS, some level of these conditions have been added to the benchmark landscape in the FEIS. These structural conditions provide additional habitat diversity (including optimal conditions for some species) and were likely present to some extent on the historical landscape. They would have occurred as part of the development history of some stands, especially those established in areas with lower levels of disturbance (generally the more mesic sites). Histories of these stands would still need to incorporate some ecological disturbance surrounding periods of forest regeneration; however, such disturbance may have been more episodic than regular. To model this complexity for a benchmark landscape, we have simplified disturbance regimes into three types:

    1) **Woodland Regime**--frequent and regular disturbance from ground fires and grazing which results in maintenance of a very open woodland condition sustained over time by small patches of tree regeneration,

    2) **Open Forest Regime**--less frequent or intense but regular disturbance from ground fires results in maintenance open forest conditions through the life of a stand with regeneration occurring in patches created by periodic canopy disturbance, and

    3) **Closed Forest Regime**--low levels of disturbance results in closed oak forests for significant portion of a stand's history, with development of canopy gaps following stand senescence, but with more regular disturbance events providing for oak regeneration toward the end of a stand's history.

- Because of frequent low-intensity disturbances such as fire, and less frequent high-intensity disturbances such as tornados, the historical structure of oak forests on LBL probably represented some mixture of even-aged and uneven-aged conditions. However, because oak is generally intolerant of heavy shade, a two-aged model, with a uniform distribution of age classes up to the average maximum age of the index species for a site (Table 3.2.4B), was used in the DEIS to approximate the benchmark landscape condition. Index species chosen for oak forests in the DEIS were all white oak species, which tend to be the longest-lived species within these forest types. However, input from scientific review of the DEIS raised concerns that shorter-lived species, especially red oaks, may not be adequately sustained and represented on the landscape under the assumption that oak forests are uniformly distributed across the age span of long-lived white oaks. Red oaks are ecologically important as a complement to white oaks in providing consistent mast crops. To address this concern in the FEIS, for the benchmark landscape, a portion of the total oak forest acreage is assumed to be uniformly distributed up to the average age of senescence for selected index red oak species (Table 3.2.4D). The remaining portion is treated as discussed in the DEIS.

- Considerations raised during scientific review described above were combined as shown in Table 3.2.4E to create a template for assigning optimal benchmark levels by categories of disturbance regime and maximum stand age. These figures were then used to calculate optimal benchmark percentages for oak forest structure types by site type (Table 3.2.4C). These calculations result in a larger percentage of oak forest acreage in younger age classes on the benchmark landscape (though potential old growth remains very abundant). This condition is likely to be a better reflection of historical age classes on the benchmark landscape. This is reasonable to assume because the probability for a stand to avoid regenerating disturbances and make it to the oldest age classes would be relatively low in comparison to the probability of it being regenerated during some younger age class. These calculations also reflect some portion of the oak forest in mature closed and mature with canopy gap structural conditions.

- In addition to creating some grassland on xeric and dry sites, American Indian use of fire maintained some portion of the oak forest on these sites in open oak woodland. As with grassland, determining this historical proportion with precision is not possible, but it undoubtedly was a more common condition than that found today. Woodlands were most abundant on xeric sites.

Table 3.2.4C - Percentages of structure type by site type within **Oak Forests on all site types** that represent the **“optimal” benchmark** for sustaining diversity of plant and animal communities and viability of associated species on Land Between The Lakes.

Percent Compositionally Stable and Un-stable Oak Forests and Structure by Site Type						
Structure Type	**Xeric**	**Dry**	**Dry-Mesic**	**Mesic**	**Alluvial**	**% of Forest Type**
Mature Closed	0.0%	3.3%	10.0%	21.9%	21.9%	6.6%
Mature Open	26.8%	34.6%	53.0%	38.3%	38.3%	42.4%
Mature Woodland	60.0%	40.0%	0.0%	0.0%	0.0%	22.2%
Mature with Gaps	0.0%	1.1%	4.5%	11.1%	11.1%	2.8%
Mid-aged	6.6%	10.5%	16.3%	14.4%	14.4%	13.0%
Young	4.4%	7.0%	10.8%	9.6%	9.6%	8.7%
Regenerating	2.2%	3.5%	5.4%	4.8%	4.8%	4.3%
Total	100.0%	100.0%	100.0%	100.0%	100.0%	100.0%

Table 3.2.4D - Average maximum age, average age at senescence, and minimum "old growth" age for **Red Oak index** species selected for each site type, Land Between The Lakes.

Red Oak Index Species	Scarlet oak	Black oak	Black oak	Cherry-bark oak	Cherry-bark oak
Avg. Maximum Age	170	210	210	240	240
Avg. Age at Senescence	100	130	130	140	140
Min. Old Growth Age	90	120	120	120	120
Area per 10-yr Age-Class based on uniform distribution up to Avg. Age at Senescence	10.0%	7.7%	7.7%	7.1%	7.1%
Percent Old Growth	10.0%	7.7%	7.7%	14.3%	14.3%

3.2.4E - Optimal benchmarks categories of disturbance regime by site type.						
Percent by Site Type						
Disturbance Regime	**Xeric**	**Dry**	**Dry-Mesic**	**Mesic**	**Alluvial**	**% of Oak Forest**
Woodland	60.0%	40.0%	0.0%	0.0%	0.0%	22.2%
Open/White Oak	30.0%	20.0%	35.0%	25.0%	25.0%	26.8%
Open/Red Oak	10.0%	30.0%	35.0%	15.0%	15.0%	31.3%
Closed/White Oak	0.0%	3.0%	12.0%	30.0%	30.0%	7.5%
Closed/Red Oak	0.0%	7.0%	18.0%	30.0%	30.0%	12.2%
Total	**100.0%**	**100.0%**	**100.0%**	**100.0%**	**100.0%**	**100.0%**
Total Open						**58.1%**
Total Closed						**19.7%**
Total White Oak						**34.3%**
Total Red Oak						**43.5%**

A comparison of the benchmark condition with current conditions reveals the following differences (see Appendix E, Table E.2) and potential management actions:

- Mature closed oak forests are currently in much greater supply than the benchmark condition; mature open oak forests are at relatively low levels. To restore mature open oak forest on LBL would require thinning mature closed oak forest and maintaining these conditions with prescribed burning.

- Mature oak woodland is currently in short supply relative to the benchmark condition. This condition may be increased by thinning oak forests and reintroducing fire to maintain open conditions.

- Young oak forests are abundant relative to the benchmark condition, but regenerating oak forests are less than benchmark condition. Old growth oak forests are rare to absent—well below benchmark conditions. Improving age diversity would require allowing some forests to continue to age, while periodically regenerating others (see Old Growth part of this section).

- Mature oak forest with canopy gaps are below benchmark levels. Increasing this element of structural diversity may be accomplished through creation of canopy gaps in the short-term or waiting for natural senescence in the long-term.

Using the process described in Section 3.2.1, expected outcomes for acreage of Oak Forests and associated structural conditions were calculated for each alternative (Table 3.2.4F). Also following the process described in Section 3.2.1, Key Factors, Indicators, and Thresholds for “very good,” “good,” “fair,” and “poor” conditions were identified for Oak Forests (Table 3.2.4G). Expected acreage outcomes were then rated according to these thresholds (Table 3.2.4H).

Table 3.2.4F - Expected acreage of **Oak Forest on all Site Types** in 10 and 50 years under Alternatives W, X, Y, and Z for Land Between The Lakes of LBL 2004.

Cover Type	Current		Optimal		Alt W			Alt X			Alt Y			Alt Z	
Structure Type	**Acres**		**Acres**		**10 Yrs**	**50 Yrs**		**10 Yrs**	**50 Yrs**		**10 Yrs**	**50 Yrs**		**10 Yrs**	**50 Yrs**
Compositionally Stable Oak Forest	73327		74506		73327	73327		73267	73167		73267	73167		73267	73167
Mature Closed	43618		2334		32317	21696		37117	16856		37117	16856		41617	39206
Mature Open	10059		25537		14259	31059		10014	9614		10014	9614		9414	6464
Mature Woodland	0		30420		0	0		6000	30000		6000	30000		3000	15300
Mature With Gaps	55		796		9715	19375		0	0		0	0		0	0
Mid-aged	7678		7710		10479	1196		10479	7396		10479	7396		10479	5596
Young	10721		5140		6557	0		6557	6200		6557	6200		6557	4400
Regenerating	1196		2570		0	0		3100	3100		3100	3100		2200	2200
Compositionally Un-Stable Oak Forest	67471		62423		67471	67471		67411	67461		67411	67461		67411	67561
Mature Closed	40878		6658		40103	46370		36443	28210		36443	28210		39643	44210
Mature Open	5787		32582		5479	4247		8968	21368		8968	21368		7068	11868
Mature Woodland	0		0		0	0		0	0		0	0		0	0
Mature With Gaps	65		3018		65	65		1184	5984		1184	5984		584	2984
Mid-aged	6076		10082		10759	7465		10759	5599		10759	5599		10759	4299
Young	13417		6722		7957	6216		7957	4200		7957	4200		7957	2800
Regenerating	1249		3361		3108	3108		2100	2100		2100	2100		1400	1400

Table 3.2.4G - Key Factors, Indicators, and Thresholds for the Conservation Target: **Oak Forests on all Site Types**

Key Factor	Indicator	Optimal Bench-mark	Very Good is >	Good is>	Fair is>	Poor is<
Amount of oak forest	Acres of oak forest	136,929	102,697	684,65	34,232	34,232
Amount of oak forest managed for open or woodland condition	Acres of oak with open forest or woodland structure	88,538	66,404	44,269	22,135	22,135
Amount of oak woodland	Acres of oak woodland	30,420	22,815	15,210	7,605	7,605
Amount of compositionally unstable oak forest managed for sustained oak dominance	Acres of compositionally unstable oak managed for sustained oak	52,747	39,560	26,373	13,187	13,187
Amount of regenerating oak forest (two-aged)	Acres of regenerating oak Forest	5,931	5,041	3,558	2,076	2,076
Amount of mature oak forest	Acres of mature oak forest	101,345	76,009	50,672	25,336	25,336

Table 3.2.4H - Oak Forest on all Site Types indicator levels and ratings (VG= very good, G= good, F=fair, and P=poor) for current conditions and 10- and 50-year future conditions under Area Plan Alternatives W, X, Y, and Z for Land Between The Lakes, 2004.

			Indicator Level								
Key Factor	**Current**		**10 Years**					**50 Years**			
(Indicator)			**W**	**X**	**Y**	**Z**		**W**	**X**	**Y**	**Z**
Amount of oak forest (Acres)	140,798		140,798	140,678	140,678	140,678		140,798	140,628	140,628	140,728
(Rating)	VG		VG	VG	VG	VG		VG	VG	VG	VG
Amount of oak forest managed for open or woodland condition (Acres)	15,846		19,738	24,982	24,982	19,482		35,306	60,982	60,982	33,632
(Rating)	P		P	F	F	P		F	G	G	F
Amount of oak woodland (Acres)	0		0	6,000	6,000	3,000		0	30,000	30,000	15,300
(Rating)	P		P	P	P	P		P	VG	VG	G
Amount of compositionally unstable oak managed for sustained oak (Acres)	26,528		27,303	29,784	29,784	27,184		21,036	33,267	33,267	20,367
(Rating)	G		G	G	G	G		F	G	G	F
Amount of regenerating oak (Acres)	2,445		3,108	5,200	5,200	3,600		3,108	5,200	5,200	3,600
(Rating)	G		F	VG	VG	G		F	VG	VG	G
Amount of mature oak forest (Acres)	100,461		101,938	99,726	99,726	101,326		122,813	112,033	112,033	120,033
(Rating)	VG		VG	VG	VG	VG		VG	VG	VG	VG

The indicator levels and ratings in Table 3.2.4H were derived from Table 3.2.4G, the combined expected acreage for all oak forests for the 10 and 50 year periods in each alternative.

Total amount of oak forest varies little across alternatives in both the short-and long-term. Because of oak forest's dominance on the landscape, current and all future outcomes are rated "very good." Total acreage of mature oak, similarly, is abundant across all alternatives and time periods. Acreage in mature open or woodland structural condition is less favorable, though improves over time under all alternatives due to thinning and/or woodland restoration. This indicator exceeds the "good" threshold only for Alternatives X and Y in 50 years, largely because of these alternatives relatively high levels of woodland restoration.

Levels of regenerating oak forest are currently rated as "good." Sustained levels of regeneration under Alternative W are only rated as "fair," while Alternatives X and Y provide "very good" levels and Alternative Z provides "good' levels. Management of compositionally unstable oak forests to sustain oak dominance is currently "good" and remains so under all alternatives in the first 10 years. In 50 years, Alternatives W and Z fall to "fair" because these alternatives include lower levels of forest thinning.

Management Indicator Species

The prairie warbler (*Dendroica discolor*) was selected to help indicate the effectiveness of management in restoring oak woodlands. The key breeding habitat requirements for this species are saplings and shrubs, usually in open country and in poor soil (Hamel, 1992). The oak woodland is considered suitable habitat for this species beginning about five years after the area has been created (NatureServe 2003). Based on Table 3.2.4H, Alternatives X and Y would provide the most habitat, and Alternative W would not provide this type habitat as none would be created (Table 3.2.4I). Because of the relatively large increases in habitat projected in 50 years under Alternatives X and Y (Table 3.2.4I), changes in prairie warbler population levels are expected to increase over time. Smaller increases in this habitat under Alternative X are expected to result in correspondingly smaller population increases.

Cumulatively, on LBL and surrounding lands, prairie warblers may find habitat in forest regeneration areas. However quality habitats are limited. This species is indentified as a species of conservation priority (Ford *et. al.,* 2000) due to population declines range-wide and in the physiographic region (Sauer *e.t al.,* 2004). Habitat restoration efforts on LBL represent an important contribution to physiographic area objectives (Ford *et. al.,* 2000).

Table 3.2.4I - Expected population trend[1] of the prairie warbler on LBL under each alternative for 10 and 50 years following Area Plan adoption. Population trend estimates are based on expected trends in habitat quantity and quality.				
	Alternative			
Time Period	W	X	Y	Z
10 years	=	+	+	+
50 years	=	++	++	++
[1]Population trend expressed as expected change from current levels: "++" = relatively large increase, "+" = increase, "=" = little to no change, "-" = decrease, "- -" = relatively large decrease.				

The great crested flycatcher (*Myiarchus crinitus*) was selected as an indicator to represent the mature open oak forest conditions of the oak forest types. Key breeding habitat requirements for this species includes generally somewhat open forests with a suitable cavity for a nest (Hamel 1992). This species is also associated with hardwood woodland habitat (Hamel 1992 and NatureServe 2004). The current total acres of mature open oak forest are 15,846 acres (Table 3.2.4G). The combined totals of open oak forest for each alternative for 10 and 50 years is provided in Table 3.2.4J.

Table 3.2.4J - Total acres of compositionally stable and unstable mature open oak forest				
	Alternative			
Time Period	W	X	Y	Z
10 years	19,738	18,982	18,982	16,482
50 years	35,306	30,982	30,982	18,332

Based on Table 3.2.4J, there is an increase in the amount of mature open oak forest in Alternatives W, X, and Y and not much change in Alternative Z for the 10 and 50 year periods. Over the next 50 years there would be a relatively large increase in available habitat for the greatcrested flycatcher in Alternatives W, X, and Y. The greater amount of mature open oak forest habitat in Alternative W in 50 years, compared to alternatives X, Y, and Z, is a result of an emphasis on creating open oak forest and not creating oak woodland (Table 3.2.4K).

Table 3.2.4K - Expected population trend[1] of the great crested flycatcher on LBL under each alternative for 10 and 50 years following the Area Plan adoption. Population trend estimates are based on expected trends in habitat quantity and quality.				
	Alternative			
Time Period	W	X	Y	Z
10 years	+	+	+	=
50 years	++	++	++	+
[1]Population trend expressed as expected change from current levels: "++" = relatively large increase, "+" = increase, "=" = little to no change, "-" = decrease, "- -" = relatively large decrease.				

Mesophytic Forests

Mesophytic Forests (Table 3.2.4L) include:

- Mesophytic Forests are dominated by shade tolerant tree species such as maple and beech; maple to a greater extent than beech. They typically replace themselves through creation of canopy gaps caused by single or small groups of dying trees. Fire is not a major factor in their regeneration. For this reason, the predominate structure in the benchmark condition is mature forest with canopy gaps, which represents an uneven-aged forest condition.

- More intensive disturbances, such as tornados, do have some effect on Mesophytic Forests; therefore, a relatively small percentage of this forest type is assigned to a two-aged condition as part of the benchmark condition.

- Because fire does not play an important role in maintenance of this forest type, Mature Open Forest and Mature Woodland are not appropriate structural types.

Table 3.2.4L - Percentages of structure type by site type within **Mesophytic Forests** that are deemed an **"optimal" benchmark** for sustaining diversity of plant and animal communities and viability of associated species, Land Between The Lakes.

Mesophytic Forest and Structure Acres by Site Type						
Structure Type	**Xeric**	**Dry**	**Dry-Mesic**	**Mesic**	**Alluvial**	**% of Forest Type**
Mature Closed	16.4%	16.4%	16.4%	16.4%	16.4%	16.4%
Mature Open	0.0%	0.0%	0.0%	0.0%	0.0%	0.0%
Mature Woodland	0.0%	0.0%	0.0%	0.0%	0.0%	0.0%
Mature with Gaps	80.0%	80.0%	80.0%	80.0%	80.0%	80.0%
Mid-aged	1.8%	1.8%	1.8%	1.8%	1.8%	1.8%
Young	1.2%	1.2%	1.2%	1.2%	1.2%	1.2%
Regenerating	0.6%	0.6%	0.6%	0.6%	0.6%	0.6%
Total	100.0%	100.0%	100.0%	100.0%	100.0%	100.0%

A comparison of the benchmark condition with current conditions reveals the following differences (see Appendix E, Table E.2) and potential management actions:

- Total acreage of Mesophytic Forest is currently much below benchmark conditions due to extensive loss of this type from creation of large reservoirs. This overall shortage of Mesophytic Forest results in shortages of structure types, especially *Mature Forest with Gaps* and *Mature Closed Forest*. Large increases in this cover type are expected in the long term (beyond 50 years) as oak overstory trees in Successional Oak Forests die and mesophytic species respond by growing into the overstory. Management actions could speed this conversion by removing some oak overstory. Development of canopy gaps, a characteristic of older forests, will also occur naturally over time, but could be speeded by creating gaps through vegetation management.

Using the process described in Section 3.2.1, expected outcomes for acreage of Mesophytic Forests and associated structural conditions were calculated for each alternative (Table 3.2.4M). Also following the process described in Section 3.2.1, Key Factors, Indicators, and Thresholds for “very good,” “good,” “fair,” and “poor” conditions were identified for Mesophytic Forests (Table 3.2.4N). Expected acreage outcomes were then rated according to these thresholds (Table 3.2.4O).

Table 3.2.4M - Expected acreage by **Mesophytic Forest Cover Type and Condition** in 10- and 50-years under Alternatives W, X, Y, and Z for Land Between The Lakes, 2004.

Cover Type	Current	Optimal	Alt W		Alt X		Alt Y		Alt Z	
Structure Type	**Acres**	**Acres**	**10 Yrs**	**50 Yrs**	**10 Yrs**	**50 Yrs**	**10 Yrs**	**50 Yrs**	**10 Yrs**	**50 Yrs**
Mesophytic Forest	6580	17069	6580	6580	6580	6580	6580	6580	6580	6580
Mature Closed	3781	2793	3721	5455	3633	5015	3633	5015	3758	5640
Mature Open	306	0	306	0	306	0	306	0	306	0
Mature Woodland	0	0	0	0	0	0	0	0	0	0
Mature With Gaps	0	13656	0	0	200	1000	200	1000	100	500
Mid-aged	458	310	1291	489	1291	265	1291	265	1291	215
Young	1971	207	1050	424	1050	200	1050	200	1050	150
Regenerating	65	103	212	212	100	100	100	100	75	75

Table 3.2.4N - Key Factors, Indicators, and Thresholds for the Conservation Target**: Mesophytic Forests**

Key Factor	Indicator	Optimal Acres	Very Good is >	Good is >	Fair is >	Poor is <
Amount of mesophytic forest	Acres of mesophytic forest	17,069	14,509	10,242	5,974	5,974
Amount of mesophytic forest with complex structures (canopy gaps)	Acres of mesophytic forest with complex structures (canopy gaps)	13,656	11,607	8,193	4,779	4,779
Amount of regenerating mesophytic forest (two-aged)	Acres of regenerating mesophytic forest (two-aged)	103	98	72	47	47
Amount of mature mesophytic forest	Acres of mature mesophytic forest	16,449	13,981	9,869	5,757	5,757

Table 3.2.4O - Mesophytic Forest indicator levels and ratings (VG=very good, G=good, F=fair, and P=poor) for current conditions and 10- and 50-year future conditions under Area Plan Alternatives W, X, Y, and Z for Land Between The Lakes, 2004.

			Indicator Level								
Key Factor	**Current**		**10 Years**					**50 Years**			
(Indicator)			**W**	**X**	Y	**Z**		**W**	**X**	Y	**Z**
Amount of mesophytic forest (Acres)	6,580		6,580	6,580	6,580	6,580		6,580	6,580	6,580	6,580
(Rating)	F		F	F	F	F		F	F	F	F
Amount of mesophytic forest with complex structures (Acres)	0		0	200	200	100		0	1,000	1,000	500
(Rating)	P		P	P	P	P		P	P	P	P
Amount of two-aged regenerating mesophytic forest (Acres)	65		212	100	100	75		212	100	100	75
(Rating)	F		VG	VG	VG	G		VG	VG	VG	G
Amount of mature mesophytic forest (Acres)	4087		4,027	4,139	4,139	4,164		5,455	6,015	6,015	6,140
(Rating)	P		P	P	P	P		P	F	F	F

The amount of mesophytic forest does not change across the alternatives. This forest cover type currently represents four percent of the total acres in LBL.

Although the rating for the amount of complex structures will not change in the 10- and 50-year periods, canopy gap creation will provide some structural diversity in this mostly closed canopy forest type. The abundance of two-aged regenerating, mature, and old growth mesophytic forests is not predicted to change much from current levels (see Old Growth part of this section).

Management Indicator Species

The wood thrush (*Hylocichla mustelina*) has been selected as an indicator species to help indicate the effects of management on mesophytic forests. This species favors deciduous or mixed forest with a fairly well-developed deciduous understory, especially where moist (Hamel, 1992 and NatureServe, 2003). Its association with well-developed understories may make it especially useful in assessing the effectiveness of management for canopy gaps and complex structure in mesic forests. For this reason it will also be used to help assess effects of management on the structure of Riparian Forest (see section on Riparian Forest). In addition, the wood thrush has been selected to help indicate effects of management on forest interior birds because of its sensitivity to cowbird parasitism. Analysis of effects of alternatives on wood thrush populations is presented in the section on Forest Interior Bird Habitat.

Based on Table 3.2.4O, there would be an increase in this habitat type in all of the alternatives in the next 10 and 50 years except Alternative W (Table 3.2.4P). Management for canopy gaps and complex structure would not be prescribed for this forest type in Alternative W.

Table 3.2.4P - Expected population trend[1] of wood thrush on LBL under each alternative for 10 and 50 years following Area Plan adoption. Population trend estimates are based on expected trends in habitat quantity and quality.

Time Period	Alternative			
	W	X	Y	Z
10 years	=	+	+	+
50 years	=	+	+	+

[1]Population trend expressed as expected change from current levels: "++" = relatively large increase, "+" = increase, "=" = little to no change, "-" = decrease, "- -" = relatively large decrease.

Riparian Forests

Factors considered in setting "optimal" benchmark condition for structure within Riparian Forests (Table 3.2.4Q) include:

- Riparian Forests share some characteristics with Mesophytic Forests in not being dependent on fire for maintaining themselves. Therefore, a good proportion, 60 percent, are assigned to an optimal benchmark condition of *Mature Forest with Canopy Gaps*. This structure represents an uneven-aged forest condition.

- Riparian forest has been historically subject to more intensive disturbances than mesophytic forests, such as flooding, beaver activity, and American Indian clearing. As a result, many associated tree species, such as sweetgum and sycamore, are relatively intolerant of shade and relatively short-lived. For this reason, a larger percentage of this type is assigned to two-aged structural conditions.

- Because fire is not a major factor in this forest type, mature open forest and Mature Woodland are not appropriate structure types.

Table 3.2.4Q - Percentages of structure type by site type within **Riparian Forests** that are deemed an **"optimal" benchmark** for sustaining diversity of plant and animal communities and viability of associated species, Land Between The Lakes.

Riparian Forest and Structure Percentage by Site Type						
Structure Type	**Xeric**	**Dry**	**Dry-Mesic**	**Mesic**	**Alluvial**	**% of Forest Type**
Mature Closed	28.0%	28.0%	28.0%	28.0%	28.0%	28.0%
Mature Open	0.0%	0.0%	0.0%	0.0%	0.0%	0.0%
Mature Woodland	0.0%	0.0%	0.0%	0.0%	0.0%	0.0%
Mature with Gaps	60.0%	60.0%	60.0%	60.0%	60.0%	60.0%
Mid-aged	6.0%	6.0%	6.0%	6.0%	6.0%	6.0%
Young	4.0%	4.0%	4.0%	4.0%	4.0%	4.0%
Regenerating	2.0%	2.0%	2.0%	2.0%	2.0%	2.0%
Total	**100.0%**	**100.0%**	**100.0%**	**100.0%**	**100.0%**	**100.0%**

A comparison of the benchmark condition with current conditions reveals the following differences (see Appendix E, Table E.2) and potential management actions:

- Total acreage of Riparian Forest is near benchmark conditions, but less of it occurs on riparian sites than is desirable. Management could increase acreage of Riparian Forest on these sites by converting some existing Grasslands and Cultivated Lands.

- Riparian Forest in a structural condition of Mature Forest with Canopy Gaps is currently lacking relative to benchmark conditions. Development of canopy gaps, a characteristic of older forests, will occur naturally over time, but could be speeded by creating gaps through vegetation management.

Using the process described in Section 3.2.1, expected outcomes for acreage of Riparian Forests and associated structural conditions were calculated for each alternative (Table 3.2.4R). Also following the process described in Section 3.2.1, Key Factors, Indicators, and Thresholds for "very good," "good," "fair," and "poor" conditions were identified for

Mesophytic Forests (Table 3.2.4S). Expected acreage outcomes were then rated according to these thresholds (Table 3.2.4T).

Table 3.2.4R - Expected acreage by **Riparian Forest Cover Type and Condition** in 10 and 50 years under Alternatives W, X, Y, and Z for Land Between The Lakes, 2004.

Cover Type/	Current	Optimal	Alt W		Alt X		Alt Y		Alt Z	
Structure Type	**Acres**	**Acres**	**10 Yrs**	**50 Yrs**	**10 Yrs**	**50 Yrs**	**10 Yrs**	**50 Yrs**	**10 Yrs**	**50 Yrs**
Riparian Forest	5515	5132	5515	5515	5515	5965	5515	5965	5515	6215
Mature Closed	1913	1437	1902	4429	1814	2989	1814	2989	1939	4014
Mature Open	97	0	97	0	97	0	97	0	97	0
Mature Woodland	0	0	0	0	0	0	0	0	0	0
Mature With Gaps	0	3079	0	0	200	2000	200	2000	100	1100
Mid-aged	604	308	1840	450	1840	676	1840	676	1840	876
Young	2875	205	1463	424	1463	200	1463	200	1463	150
Regenerating	26	103	212	212	100	100	100	100	75	75

Table 3.2.4S - Key Factors, Indicators, and Thresholds for the Conservation Target: **Riparian Forests**

Key Factor	Indicator	Optimal Acres	Very Good is >	Good is >	Fair is >	Poor is <
Amount of riparian forest	Acres of riparian forest	5,132	4,362	3,079	1,796	1,796
Amount of riparian forest with complex structures	Acres of riparian forest with complex structures	3,079	2,617	1,848	1,078	1,078
Amount of regenerating riparian forest (two-aged)	Acres of regenerating riparian forest (two-aged)	103	98	72	46	46
Amount of mature riparian forest	Acres of mature riparian forest	4,516	3,839	2,710	1,581	1,581

Table 3.2.4T - Riparian Forest indicator levels and ratings (VG=very good, G=good, F=fair, and P=poor) for current conditions and 10- and 50-year future conditions under Area Plan Alternatives W, X, Y, and Z for Land Between The Lakes, 2004.

			Indicator Level								
Key Factor	**Current**		**10 Years**					**50 Years**			
(Indicator)	**Level**		**W**	**X**	Y	**Z**		**W**	**X**	Y	**Z**
Amount of riparian forest (Acres)	5515		5515	5515	5515	5515		5515	5965	5965	6215
(Rating)	**VG**		VG	VG	VG	VG		VG	VG	VG	VG
Amount of riparian forest with complex structures (canopy gap) (Acres)	0		0	200	200	100		0	2000	2000	1100
(Rating)	**P**		P	P	P	P		P	G	G	F
Amount of two-aged regenerating riparian forest (Acres)	26		212	100	100	75		212	100	100	75
(Rating)	**P**		VG	VG	VG	G		VG	VG	VG	G
Amount of mature riparian forest (Acres)	2010		2000	2112	2112	2137		4430	4990	4990	5115
(Rating)	**F**		F	F	F	F		VG	VG	VG	VG

The indicator levels and ratings in Table 3.2.4T were derived from Table 3.4.2R, the expected acreage for riparian forests for the 10- and 50-year periods in each alternative.

The amount of riparian forest does not change across the alternatives. This forest cover type currently represents three percent of the total acres in LBL.

In the first decade, the rating does not change for the amount of complex structures however, through canopy gap treatments, 1000 acres are created and the structural diversity of this cover type improves in the next four decades except in Alternative Z where there would be a reduction in forest vegetation management.

The regeneration of riparian forest improves considerably in Alternatives X and Y during the 10 and 50 year periods and only the first decade for Alternative Z. There isn't an emphasis for regeneration of riparian forest in Alternative W or as much of an emphasis for Alternative Z in the next four decades compared to Alternatives X and Y.

During the first decade there is slight increase in the amount of mature riparian forest and over the 50-year period there is a considerable increase in the amount of mature forest. This is as a result of fewer trees desired overall in mid-aged and young structure than currently exists in acres, and these trees will mature and count toward the total acres in mature forest.

The rating for the amount of old growth is not projected to change in the 10- and 50-year periods except for Alternative W in 50 years, where there would be an increase in the total acres of old growth from current conditions. As noted above, there is a desire to have fewer total acres in mid-aged and young forest conditions and in Alternative W there aren't any acres projected for regeneration. The acres that are not planned for regeneration, and the acres not intended to be retained in mid-aged and young forest, would count toward the higher total acres of old growth in Alternative W (see Old Growth part of this section).

Management Indicator Species

The Acadian flycatcher (*Empidonax virescens*), that favors rich deciduous forest with moderate understory and along streams (Hamel, 1992), was selected as an indicator to represent these habitat conditions within mature riparian forest. Based on Table 3.2.4T, mature riparian forest, there would be little change across the alternatives in 10 years (Table 3.2.4U). In 50 years there would be a relatively large increase in mature riparian forest for all of the alternatives.

Table 3.2.4U - Expected population trend[1] of Acadian flycatcher on LBL under each alternative for 10 and 50 years following Area Plan adoption. Population trend estimates are based on expected trends in habitat quantity and quality.				
	Alternative			
Time Period	W	X	Y	Z
10 years	=	=	=	=
50 years	++	++	++	++
[1]Population trend expressed as expected change from current levels: "++" = relatively large increase, "+" = increase, "=" = little to no change, "-" = decrease, "- -" = relatively large decrease.				

As described in the Mesophytic Forest section, the wood thrush has been selected to help indicate effects on complex structures within Mesophytic Forests. Because similar habitat conditions may occur within Riparian Forests, it will also be used to help indicate effects of management within this forest type. Analysis of effects of alternatives on wood thrush populations is presented in the section on Forest Interior Bird Habitat.

Based on Table 3.2.4T, amount of riparian forest with complex structures (canopy gaps), there would be an increase in this habitat type in all of the alternatives in the next 10 and 50 years except Alternative W (Table 3.2.4V). In 50 years, there would be a relatively large increase in mature riparian forest in Alternatives X and Y. Management for canopy gaps and complex structure would not be prescribed for this forest type in Alternative W.

Table 3.2.4V - Expected population trend[1] of wood thrush on LBL under each alternative for 10 and 50 years following Area Plan adoption. Population trend estimates are based on expected trends in habitat quantity and quality.				
	Alternative			
Time Period	W	X	Y	Z
10 years	+	+	+	+
50 years	+	++	++	+
[1]Population trend expressed as expected change from current levels: "++" = relatively large increase, "+" = increase, "=" = little to no change, "-" = decrease, "- -" = relatively large decrease.				

Shortleaf Pine Forest

Factors considered in setting "optimal" benchmark condition for structure within Shortleaf Pine Forests (Table 3.2.4W) include:

- Shortleaf pine is a shade intolerant, fire-adapted species. It needs open forest conditions to produce good seed crops, and periodic fire to expose seedbeds and maintain open conditions necessary for development of regeneration. Historically, this fire was present in large part due to American Indian use of fire. For these reasons, Mature Closed Canopy structures are not optimal.

- American Indian use of fire maintained some portion of the shortleaf pine forest in open pine or pine-oak woodlands. Woodland conditions would have been most abundant on xeric sites.

- A two-aged model, with the oldest age class moving toward the maximum average age of shortleaf pine (Table 3.2.4W), was assumed as the standard forest condition. Age diversity within mature woodland is expected to develop over time as regeneration becomes established and survives the variable intensities of prescribed fire. This sequence of events is expected to create an uneven-aged forest structure with very low tree densities.

A comparison of the benchmark condition with current conditions reveals that Shortleaf Pine Forests are below levels indicated by benchmark conditions (see Appendix E, Table E.2). Current acreage is in Mature Closed Forest condition, which is not optimal. Thinning of current pine forest, as well as surrounding oak-dominated forest, and reintroducing fire would improve structural conditions and increase acreage of Shortleaf Pine Forest (Franklin and Kupfer, 2000).

Using the process described in Section 3.2.1, expected outcomes for acreage of Shortleaf Pine Forests and associated structural conditions were calculated for each alternative (Table 3.2.4X). Also following the process described in Section 3.2.1, Key Factors, Indicators, and Thresholds for “very good,” “good,” “fair,” and “poor” conditions were identified for Oak Forests (Table 3.2.4Y). Expected acreage outcomes were then rated according to these thresholds (Table 3.2.4Z).

Table 3.2.4W - Acres of structure type by site type within a **Shortleaf Pine Forest** that represent the **"optimal" benchmark** condition for sustaining diversity of plant and animal communities and viability of associated species, Land Between The Lakes.

Shortleaf Pine Forest and Structure Acres by Site Type						
Structure Type	**Xeric**	**Dry**	**Dry-Mesic**	**Mesic**	**Alluvial**	**% of Forest Type**
Mature Closed	0.0%	0.0%	0.0%	0.0%	0.0%	0.0%
Mature Open	28.6%	57.1%	71.4%	71.4%	71.4%	0.7%
Mature Woodland	60.0%	20.0%	0.0%	0.0%	0.0%	0.3%
Mature with Gaps	0.0%	0.0%	0.0%	0.0%	0.0%	0.0%
Mid-aged	5.7%	11.4%	14.3%	14.3%	14.3%	0.1%
Young	3.8%	7.6%	9.5%	9.5%	9.5%	0.1%
Regenerating	1.9%	3.8%	4.8%	4.8%	4.8%	0.0%
Total	100.0%	100.0%	100.0%	100.0%	100.0%	1.2%

Table 3.2.4X - Expected acreage by **Shortleaf Pine-Oak Forest Cover Type and Condition** in 10 and 50 years under Alternatives W, X, Y, and Z for Land Between The Lakes, 2004.

Cover Type	Current		Optimal		Alt W			Alt X			Alt Y			Alt Z	
Structure Type	**Acres**		**Acres**		**10 Yrs**	**50 Yrs**		**10 Yrs**	**50 Yrs**		**10 Yrs**	**50 Yrs**		**10 Yrs**	**50 Yrs**
Shortleaf Pine-Oak Forest	130		1,637		130	130		250	450		250	450		250	450
Mature Closed	128		0		128	128		0	0		0	0		0	0
Mature Open	2		906		2	2		130	130		130	130		130	130
Mature Woodland	0		368		0	0		120	120		120	120		120	120
Mature With Gaps	0		0		0	0		0	0		0	0		0	0
Mid-aged	0		181		0	0		0	50		0	50		0	50
Young	0		121		0	0		0	100		0	100		0	100
Regenerating	0		60		0	0		0	50		0	50		0	50

Table 3.2.4Y - Key Factors, Indicators, and Thresholds for the Conservation Target: **Shortleaf Pine Forest**

Key Factor	Indicator	Optimal Acres	Very Good is >	Good is >	Fair is >	Poor is <
Amount of shortleaf pine forest	Acres of shortleaf pine forest	1,637	1,555	1,146	736	736
Amount of shortleaf pine forest in good reproductive condition	Acres of shortleaf pine forest in good reproductive condition	1,274	1,210	892	573	573
Amount of regenerating shortleaf pine forest (two-aged)	Acres of regenerating shortleaf pine forest (two-aged)	60	57	42	27	27
Amount of mature shortleaf pine forest	Acres of mature shortleaf pine forest	1,274	1,210	892	573	573

Table 3.2.4Z - Shortleaf Pine-Oak Forest indicator levels and ratings (VG=very good, G=good, F=fair, and P=poor) for current conditions and 10- and 50-year future conditions under Area Plan Alternatives W, X, Y, and Z for Land Between The Lakes, 2004.

			Indicator Level								
Key Factor	**Current**		**10 Years**					**50 Years**			
(Indicator)	**Level**		**W**	**X**	Y	**Z**		**W**	**X**	Y	**Z**
Amount of shortleaf pine forest (Acres)	130		130	250	250	250		130	450	450	450
(Rating)	P		P	P	P	P		P	P	P	P
Amount of shortleaf pine forest in good reproductive condition (Acres)	2		2	250	250	250		2	250	250	250
(Rating)	P		P	P	P	P		P	P	P	P
Amount of two-aged regenerating shortleaf pine forest (Acres)	0		0	0	0	0		0	50	50	50
(Rating)	P		P	P	P	P		VG	VG	VG	VG
Amount of mature shortleaf pine forest (Acres)	130		130	250	250	250		130	250	250	250
(Rating)	P		P	P	P	P		P	P	P	P

The indicator levels and ratings in Table 3.2.4Z were derived from Table 3.2.4X. The expected acreage for shortleaf pine forests for the 10- and 50-year periods in each alternative will increase in the amount of shortleaf pine from the total current acres in all of the alternatives except W. This will be as a result of creating 120 acres of pine woodland in the Devil's Backbone Natural Area where pine are being succeeded by oak. Alternative W does not cover woodland creation. In the 50-year period, it is anticipated that management of this species would extend past the Natural Area boundary and include additional acres of shortleaf pine restoration. With this extension, two-age regeneration treatment is being considered to provide for structural diversity that would include mid-aged, young, and regenerating shortleaf pine in addition to the mature open canopy shortleaf pine. The open shortleaf pine forest would be created in the first decade by thinning the current mature closed canopy forest. The amount of old growth shortleaf pine is directly correlated to the current acres in mature closed canopy (see Old Growth part of this section).

Planted Pine Forests

Because they are not a part of the overall benchmark condition, an optimal mix of structural conditions for Non-Native Pine Forest was not defined. Acreage of this type is expected to be maintained at approximately current levels under all alternatives for the foreseeable future with structure adjusted as needed to maintain health and persistence of these stands. Because of its relatively small acreage, maintenance of this type is not expected to significantly impact ability to provide desirable levels of other ecological conditions.

Old Growth

The Southern Region of the Forest Service recognizes old growth forests as a valuable natural resource worthy of protection, restoration, and management. In 1989, then-Forest Service Chief Dale Robertson issued a national position statement on old growth forests. He provided this definition in the *Guide for Conserving and Restoring Old-Growth Forest Communities on National Forests in the Southern Region*.

"Old growth forests are ecosystems distinguished by old trees and related structural attributes. Old growth encompasses the later stages of stand development that typically differ from earlier stages in a variety of characteristics which may include tree size, accumulation of large wood material, number of canopy layers, species composition, and ecosystem function."

The age at which old growth develops, and the specific structural attributes that characterize old growth, will vary widely according to forest type, climate, site conditions, and disturbance regime. Old growth in fire-dependent forest types may not differ from younger forests in the number of canopy layers or accumulation of down woody material. However, old growth is typically distinguished from younger growth by several of the following attributes:

- Large trees for the species and site;
- Wide variation in tree sizes and spacing;

- Accumulations of large-sized dead standing and fallen trees that are high relative to earlier stages;
- Decadence in the form of broken or deformed tops or boles and root decay;
- Multiple canopy layers;
- Canopy gaps and understory patchiness.

Old growth forests provide a variety of values, such as biological diversity, wildlife habitat, recreation, aesthetics, soil productivity, water quality, aquatic habitat, and cultural values as well as high-value timber products on a small scale. Forestry Report R8-FR 62 provide direction for management of old growth in R8. Current federal laws and regulations governing national forests do not specifically mandate management for old growth conditions. Various laws do, however, provide direction to the Forest Service for:

- Management of multiple natural resources and values
- Protection and recovery of Proposed, Endangered, Threatened, and Sensitive (PETS) Species
- Provision of habitats to sustain viable populations of native plants and animals
- Maintaining and enhancing the diversity of plant and animal communities.

These concerns can be addressed in part by establishing and maintaining a network of old growth across national forest system lands. In that way the concept of old growth encompasses more than the presence of "old" trees. Different forest communities reach old growth conditions at different ages, under different disturbance regimes, and via different management strategies. LBL has not conducted a preliminary inventory of old growth as required by the R8 guidelines (USDA Forest Service, 1997). Therefore, LBL cannot accurately account for the existing old growth community or communities based on the criteria listed below.

To be identified as old growth, a stand must meet four criteria:

- Minimum age of the oldest existing age class;
- Minimum basal area;
- Minimum diameter at breast height (DBH) of the largest trees in the stand;
- Disturbance history.

To address social concerns raised by the public, areas to be considered should have minimal evidence of past human disturbance. However, recent management activities that are not inconsistent with old growth, including prescribed burning, some silvicultural practices, and trail maintenance might not disqualify a stand from management as old growth.

Linkages between the R8 Old Growth Forest Communities (USDA Forest Service 1997) and LBL's descriptions of old growth forest community types are displayed in this table.

R8 Old Growth Forest Community Types	Land Between the Lakes Forest Community Types
Dry and Xeric Oak Forest, Woodland, and Savanna (Old Growth Forest Community Type 22)	Oak Forests on Xeric and Dry Sites
Dry-Mesic Oak Forest (Old Growth Forest Community Type 21)	Oak Forests on Dry-Mesic, Mesic, and Alluvial sites
Mixed Mesophytic and Western Mesophytic Forest (Old Growth Forest Community Type 5)	Mesophytic Forests
Hardwood Wetland Forest (Old Growth Community Type 10) and River Floodplain Hardwood Forest (Old Growth Forest Community Type 13)	Riparian Forests
Xeric Pine and Pine-Oak Forest and Woodland (Old Growth Forest Community Type 24)	Shortleaf Pine Forests

Three terms to be used by national forests when describing old growth are:

Existing Old Growth: Forest stands or patches that meet the age, disturbance, basal area, and tree size criteria described in the operational definitions for the 16 forest community types. A stand or patch must meet all four criteria in order to be classified as existing old growth.

The number of acres of existing old growth are not known at this time. The number of acres will not be known until an inventory has been conducted during plan implementation.

Possible Old Growth: Forest stands identified during the preliminary inventory of old growth that meet one or more of the preliminary inventory criteria. The areas of possible old growth will be used to help identify areas to consider for old growth allocation during forest plan alternative development and to establish priorities for areas of old growth field inventories during project-level planning. The identification of a stand as possible old growth infers no land management decision regarding the stand's status as existing or future old growth.

Once stands have been identified as possible old growth based on the R8 criteria for identification, then areas may be considered for old growth allocation and priorities established for areas of old growth inventories during project-level planning.

Future Old Growth: Forest stands or patches allocated to old growth through land management decisions, but which do not meet one or more of the old growth criteria in the operational definitions.

Once an LBL inventory is completed during Plan implementation, future old growth stands will be managed according to the R8 guidelines for old growth. The Core Areas are likely to contain some acres of old growth. These acres will also be identified after the inventory.

All old growth is classified as future old growth mainly due to the age criterion. Core Areas will provide the majority of forests meeting minimum old growth criterion but subject to lower levels of ecological disturbance which may not reflect historical conditions. Small stands of future old growth outside the core area will be identified at the project level and managed with silvicultural and burning treatments designed to create or manipulate conditions meeting old growth criteria.

Forested stands on LBL range from 60 to 90 years old which does not meet the age criteria to be defined as possible or existing old growth. Therefore, the old growth forest community types (acres) in LBL Core Areas based on the R8 Old growth patch size definitions will be considered Future Old Growth.

National forest lands in the Southeastern United States will contain a mix of large, medium, and small-sized old growth patches, (U.S. Forest Service, Forestry Report R8-FR 62, 1997):

- Large - old growth patches greater than 2,500 acres;
- Medium - in the absence of other criteria, old growth areas between 100 and 2,499 acres;
- Small - in the absence of other criteria, old growth areas between 1 and 99.

Table 3.2.4 AA displays future old growth forest community types (acres) across alternatives on LBL for large, medium, and small patch sizes identified in the Core Area prescription, therefore this is a conservative estimate. The amount of old growth projected in the major forest community types is based on conservative assumptions about age and condition of forest stands. Old growth conditions will be more prevalent within the oak forest community types because there are more acres on LBL in this forest type. Old growth conditions will be attained to a much lesser extent on a limited amount of riparian forest acres. Old growth of trees is attained quicker on xeric and riparian site types. The forest community structure by site type and prescriptive area will predict the kind of resource management treatments needed to attain old growth desired conditions.

All alternatives have approximately 31,000 acres of future old growth that meets the large patch size criteria. Alternative Z has approximately 3400 more acres than Alternative Y in small and medium patches of future old growth.

The amount of future old growth in the General Forest and Oak-grassland Demo areas will be addressed during plan implementation.

Table 3.2.4AA LBL Future Old Growth Community Types in Core Areas												
	Alternative W (Patch Size in Acres)			**Alternative X (Patch Size in Acres)**			**Alternative Y (Patch Size in Acres)**			Alternative Z (Patch Size in Acres)		
Patch Sizes	Large	Medium	Small	Large	Medium	Small	Large	Medium	Small	Large	Medium	Small
Oak Forests on Xeric and Dry Sites	15937	0	0	15906	1205	518	15938	1365	579	15970	1873	1501
Oak Forests on Dry-mesic, Mesic, and Alluvial Sites	10752	0	0	10672	1983	391	10753	2118	460	10791	2572	1276
Mesophytic Forests	1727	0	0	1708	245	52	1729	258	55	1731	330	133
Riparian Forests	1134	0	0	1125	108	49	1134	108	54	1137	142	98
Shortleaf Pine Forests	1172	0	0	1175	27	47	1176	34	47	1176	54	67
Total Acres	30722	0	0	30586	3568	1057	30730	3883	1195	30805	4971	3075

Old growth communities were assessed across all forested areas through the species viability assessment process (refer to major cover type discussions and Table 3.2.4AB).

Using the process described in Section 3.2.1, expected outcomes for acreage of old growth for each major forest cover type were calculated for each alternative (Table 3.2.4AC). Also following the process described in Section 3.2.1, Key Factors, Indicators, and Thresholds for "very good", "good", "fair", and "poor" conditions were identified for old growth conditions (Table 3.2.4AD). Expected acreage outcomes were then rated according to these Thresholds (Table 3.2.4AE).

The viability assessment shows a poor rating across all forest communities in 10 years, and this moves to a range of poor to very good in 50 years. Over the next decade old growth acres would increase slightly. There would be a significant increase of old growth acres over the next 50 years based on the projections of the species viability assessment (See Table 3.2.4AE).

Expected old growth within the major forest cover types LBL-wide were assessed by site type for 10 and 50 years. It is expected that the majority of future old growth acres would be those within the minimally disturbed Core Areas on LBL. The remaining portions of old growth would be from actively managed areas such as the General Forest in the form of Woodlands and Mature Open Forest.

Once an inventory of potential old growth acres has been completed during the Area Plan implementation, then those acres of expected old growth in Core Areas and other forested areas across LBL's landscape will be determined.

Table 3.2.4AB - Percentages of structure type by site type within **forest types** that represent the **"optimal" old growth benchmark** for sustaining diversity of plant and animal communities and viability of associated species on LBL.

Percent Forest and Structure by Site Type						
Forest and Structure Type	**Xeric**	**Dry**	**Dry-Mesic**	**Mesic**	**Alluvial**	**% of Forest Type**
Oak Forests						
Two-Aged	20.2%	16.8%	30.5%	31.4%	31.4%	23.2%
Woodland	60.0%	40.0%	0.0%	0.0%	0.0%	22.2%
Canopy Gaps	0.0%	1.1%	4.5%	11.1%	11.1%	2.8%
Oak Forest Total	**80.2%**	**58.0%**	**35.0%**	**42.6%**	**42.6%**	**48.2%**
Mesophytic Forest						
Two-Aged	11.5%	11.5%	11.5%	11.5%	11.5%	11.5%
Woodland	0.0%	0.0%	0.0%	0.0%	0.0%	0.0%
Canopy Gaps	80.0%	80.0%	80.0%	80.0%	80.0%	80.0%
Mesophytic Forest Total	**91.5%**	**91.5%**	**91.5%**	**91.5%**	**91.5%**	**91.5%**
Riparian Forest						
Two-Aged	20.0%	20.0%	20.0%	20.0%	20.0%	6.0%
Woodland	0.0%	0.0%	0.0%	0.0%	0.0%	0.0%
Canopy Gaps	60.0%	60.0%	60.0%	60.0%	60.0%	18.0%
Riparian Forest Total	**80.0%**	**80.0%**	**80.0%**	**80.0%**	**80.0%**	**24.1%**
Shortleaf Pine Forest						
Two-Aged	21.0%	41.9%	52.4%	52.4%	52.4%	0.5%
Woodland	60.0%	20.0%	0.0%	0.0%	0.0%	0.3%
Canopy Gaps	0.0%	0.0%	0.0%	0.0%	0.0%	0.0%
Shortleaf Pine Forest Total	**81.0%**	**61.9%**	**52.4%**	**52.4%**	**52.4%**	**0.8%**

Table 3.2.4AC - Expected acreage of **old growth** by Cover Type in 10 and 50 years under Alternatives W, X, Y, and Z for the Land Between the Lakes Land and Resource Management Plan, 2004.										
Cover Type	**Current**	**Optimal**	**Alt W**		**Alt X**		**Alt Y**		**Alt Z**	
Old Growth	**Acres**	**Acres**	**10 Yrs**	**50 Yrs**	**10 Yrs**	**50 Yrs**	**10 Yrs**	**50 Yrs**	**10 Yrs**	**50 Yrs**
Oak Forest	0	65964	713	57489	673	50104	673	50104	684	55494
Mesophytic Forest	0	15621	0	0	0	0	0	0	0	0
Riparian Forest	0	4106	0	1152	0	1712	0	1712	0	1837
Shortleaf Pine Forest	0	1032	0	130	0	250	0	250	0	250

Table 3.2.4AD - Key Factors, Indicators, and Thresholds for the Conservation Target: **Old-growth Forests**					
Key Factor: Amount of old growth forest **Indicator:** Acres of old growth forest	**Optimal Bench-mark**	**Very Good is >**	**Good is >**	**Fair is >**	**Poor is <**
Oak Forest	65,964	49,473	32,982	16,491	16,491
Mesophytic Forest	15,621	13,278	9,373	5,467	5,467
Riparian Forest	4,106	3,490	2,463	1,437	1,437
Shortleaf Pine Forest	1,032	981	723	465	465

Table 3.2.4AE - Forest old growth indicator levels and ratings (VG=very good, G=good, F=fair, and P=poor) for current conditions and 10- and 50-year future conditions under Plan Alternatives W, X, Y, and Z for Land Between The Lakes, 2004.

						Indicator Level					
Key Factor	**Current**			**10**	**Years**				**50**	**Years**	
(Indicator) : Acres of Old Growth			**W**	**X**	**Y**	**Z**		**W**	**X**	**Y**	**Z**
Oak Forest	**0**		713	673	673	684		57,489	50,104	50,104	55,494
(Rating)	**P**		P	P	P	P		VG	VG	VG	VG
Mesophytic Forest	**0**		0	0	0	0		0	0	0	0
(Rating)	**P**		P	P	P	P		P	P	P	P
Riparian Forest	**0**		0	0	0	0		1152	1712	1712	1837
(Rating)	**P**		P	P	P	P		P	F	F	F
Shortleaf Pine	**0**		0	0	0	0		130	250	250	250
(Rating)	**P**		P	P	P	P		P	P	P	P

3.2.5 Major Open Land Communities

Affected Environment

Open lands have been managed to provide for the orderly growth and development of desirable stages of early plant succession and to meet wildlife habitat needs. This has been done by managing open lands for native vegetation, grain, green forage and other cover types. Sustainable management practices have been tested and demonstrated through ecological restoration, maintenance of open lands, and agricultural practices and techniques. Management of the open lands in LBL has provided for outdoor recreation activities and environmental education.

The major open land communities within LBL have been grouped into grassland and cultivated community types for the effects analysis. The specific type of management done for each of these major community types is noted by the cover type name in Table 3.2.5A. The management of some of the openings and what they are called has changed over the years to present for various reasons. For example, some fields that were in cropland have become hayfields and some wildlife plantings are now being managed as maintained open land due to land productivity capabilities and changes in management philosophy. There is a need to evaluate the abundance of each major open land community type; identify spatially, where the open lands may be best represented on the landscape; and how the management of these types provides for species viability needs as well as for recreational demand species needs.

Grassland Cover Community Types

Maintained open lands are those identified in TVA's 1994 Plan plus some areas identified for ecological restoration of native plants. "Maintained Open Lands" are assumed not to be disked frequently enough to be classified as cropland or wildlife plantings but are best classified as grasslands. Maintenance may occur by mowing, fire, or low frequency disking.

Native grasslands are defined as grass and herb dominated areas with few to no trees (< 10 percent canopy closure) and having as little as 50 percent native grass and broadleaf herbs in dry areas with barren or bare ground and 80 percent to 100 percent native grass and broadleaf herbs on the more mesic and hydric sites. The type as noted above includes dry, mesic, and hydric grassland communities depending on site (Martin, 2003). This type is sometimes referred to as "prairie" or "barrens." This type is similar to the CES202.355 Pennyroyal Karst Plain Prairie and Barrens Ecological System described by NatureServe (2003), but technically LBL is not in the Western Pennyroyal Karst Plain Ecoregion (Chester, 2003 and Chester and Fralish, 2002). Current abundance of the type will be determined by separating this type from old fields and hayfields based on knowledge of staff and external experts. An inventory of all of the native grassland within LBL is not complete and will be determined through project level analyses.

Hayfields are open lands dominated by grasses and herbs that are annually mowed for hay under a cooperative hay farming program. The special use permits issued for this program operate under a barter system whereby a certain percentage of the hay is provided to LBL for feeding the elk and bison herds.

Old fields are open lands dominated by grasses and herbs but which do not meet the definition of native grasslands and are not regularly hayed. They may be maintained by mowing on a relatively long cycle (> 2 years), or be succeeding to forest and would include shrub growth species. Old Fields become Regenerating Forest when tree regeneration, rather than grass/herb and some shrub cover, dominates the site (generally when >100 tree seedlings per acre that exceed 3.5 feet in height and will comprise a cover type).

Road right-of-ways (ROW) are open land areas maintained annually by mowing along major roads while utility ROWs are open land areas maintained for clearance for power-lines and gas-lines.

Table 3.2.5A - Current acres of **Grassland and Cultivated Openings** by site types and percentages of cover type by site type that represent an **"optimal" benchmark** for sustaining diversity of plant and animal communities and viability of associated species, Land Between The Lakes.

	Soil Site Type					
Grassland Cover/Structure Type	**Xeric**	**Dry**	**Dry-Mesic**	**Mesic**	**Alluvial**	**Total Acres**
Maintained Openland/Open (Native grasses and forbs have been restored on 600 acres within this cover type)	144	288	222	189	266	**1,109**
Hayfield/Open	27	373	430	169	492	**1,491**
Old Field/Open	5	152	229	84	179	**649**
Road ROW/Open	81	1106	996	128	197	**2,508**
Utility ROW/Open	7	394	328	5	32	**765**
Total Acres:	264	2312	2205	576	1165	6522
Percent Optimal Grassland	5.0%	5.0%	5.0%	5.0%	5.0%	5.0%

	Soil Site Type					
Cultivated/Structure Type	**Xeric**	**Dry**	**Dry-Mesic**	**Mesic**	**Riparian**	**Total Acres**
Cropland/Open	0	19	362	823	1363	**2,567**
Wildlife Plantings/Open	37	420	487	166	448	**1,557**
Total Acres:	37	439	849	989	1811	4,124
Percent Optimal Cultivated	0.0%	0.0%	0.0%	0.0%	0.0%	**0.0%**

Cultivated Cover Community Types

Croplands are open lands that are cultivated for traditional row-crops, such as corn and soybeans, through a cooperative farming program. The croplands provide for wildlife habitat diversity at a minimal cost and demonstrate sound agricultural practices. The cooperative farming program is administered under the special-use permit system.

Wildlife plantings are open land areas maintained and planted solely for the benefit of wildlife. These are generally smaller than cropland patches, and are maintained by Forest Service or state agency staff. This open land cover type includes areas currently managed as woods openings and wildlife plantings.

The wildlife plantings are typically planted in corn or a mixture of milo/iron-clay cowpeas/Korean lespedeza or other desirable forb/legume species. Plantings result in wildlife foods available through summer, fall, and winter.

The woods openings are managed to provide green forage for wildlife habitat diversity and distribution. Most tracts are currently located where no cooperative farming occurs or in highly visible areas. They are located in interior forested areas, adjacent to roadsides, and in other areas not suitable for cooperative farming. These openings are disked and seeded in early fall to a combination of winter wheat, cool season grasses, and legumes. The areas can be mowed during the following years to maintain the grass/legume forage. The areas planted are rotated for management about every three years to the point that succession advances to the grass/legume or forb stage.

Environmental Effects

Some key factors considered when defining this benchmark condition are:

- Optimal American Indian use of fire helped create and maintain areas of Grassland especially on xeric and dry sites where fire intensity was highest. Large grazers, such as bison and elk, also helped maintain grasslands. Although it is not possible to determine with precision the range of percent of the landscape in grassland during historical reference conditions, evidence indicates that it was higher than that present today, due to recent effects of fire suppression. Distribution of grasslands across site types was likely skewed historically toward xeric and dry sites, as compared to today, where preference for creating fields on flatter fertile sites has skewed distribution of this type to more mesic sites (Table 3.2.3B). However, based on input from scientists during the review period for the DEIS, much of the dry and xeric grassland reflected in the draft benchmark has been added to oak forest type as mature woodland structure. General consensus of scientists consulted is that the woodland structure probably better reflects historical conditions on dry and xeric sites where fire was frequent.

- American Indians also cleared areas for cultivation, primarily on flat and fertile riparian sites. The benchmark condition in the DEIS included some cultivated lands for this reason. However, based on information from scientists during the review period, the draft benchmark was changed to zero.

A comparison of the benchmark condition with current conditions reveals the following differences (see Appendix E, Table E.2) and potential management actions:

- Grasslands are currently less abundant than the benchmark condition, especially on dry and dry-mesic sites. Grasslands on alluvial sites exceed benchmark conditions. Grassland type habitat conditions may be recreated on xeric and dry sites by creating woodland and reintroducing fire to these sites. On dry-mesic, grasslands may be increased by converting some Cultivated Lands.

Using the process described in Section 3.2.1, expected outcomes for acreage of Grasslands and Cultivated Lands by site type were calculated for each alternative (Table 3.2.5B). Also following the process described in Section 3.2.1, Key Factors, Indicators, and Thresholds for "very good," "good," "fair," and "poor" conditions were identified for Oak Forests (Table 3.2.5C). Expected acreage outcomes were then rated according to these thresholds (Table 3.2.5D).

Table 3.2.5B - Expected acreage by **Grassland and Cultivated Cover Type by Site Type** in 10 and 50 years under Alternatives W, X, Y, and Z for Land Between The Lakes, 2004.

Cover Type	**Current**	**Optimal**	**Alt**	**W**	**Alt**	**X**	**Alt**	**Y**	**Alt**	**Z**
Condition	**Acres**	**Acres**	**10 Yrs**	**50 Yrs**	**10 Yrs**	**50 Yrs**	10 Yrs	50 Yrs	**10 Yrs**	**50 Yrs**
Grassland	6522	8563	6522	6522	7672	7262	7672	7262	8272	7512
Xeric	264	168	264	264	264	264	264	264	264	264
Dry	2312	3840	2312	2312	2312	2312	2312	2312	2312	2312
Dry-Mesic	2205	3464	2205	2205	2205	2205	2205	2205	2205	2205
Mesic	576	449	576	576	826	676	826	676	976	726
Riparian --not Canebrake	1165	321	1165	1165	2015	1565	2015	1565	2465	1765
Riparian --Canebrake	0	321	0	0	50	240	50	240	50	240
Cultivated	4124	0	4124	4124	2974	2784	2974	2784	2374	2184

Table 3.2.5C - Key Factors, Indicators, and Thresholds for the Conservation Target: **Grasslands**

Key Factor	Indicator	Optimal Acres	Very Good is >	Good is >	Fair is >	Poor is <
Amount of grassland	Acres of grassland	8,563	6,422	4,281	2,141	2,141
Amount of grassland dominated by native grasses	Acres of grassland dominated by native grasses	8,563	6,422	4,281	2,141	2,141
Amount of grassland on xeric sites	Acres of grassland on xeric sites	168	143	101	59	59
Amount of grassland on dry sites	Acres of grassland on dry sites	3,840	3,264	2,304	1,344	1,344
Amount of grassland on dry-mesic sites	Acres of grassland on dry-mesic sites	3,464	2,945	2,079	1,213	1,213
Amount of grassland on mesic sites	Acres of grassland on mesic sites	449	382	270	157	157
Amount of grassland on riparian sites	Acres of grassland on riparian sites	641	609	449	289	289
Amount of canebrake	Acres of canebrake	321	305	225	144	144

Table 3.2.5D - Grassland indicator levels and ratings (VG=very good, G=good, F=fair, and P=poor) for current conditions and 10- and 50-year future conditions under Area Plan Alternatives W, X, Y, and Z for Land Between The Lakes, 2004.

			Indicator Level								
Key Factor	**Current**		**10 Years**					**50 Years**			
(Indicator)			**W**	**X**	**Y**	**Z**		**W**	**X**	**Y**	**Z**
Amount of grassland (Acres)	6,522		6,522	7,672	7,672	8,272		6,522	7,262	7,262	7,512
(Rating)	G		G	G	G	G		G	G	G	VG
Amount of grassland dominated by native grasses (Acres)	600		1,600	1,350	1,350	1,100		2,600	2,600	2,600	2,600
(Rating)	P		P	P	P	P		F	F	F	F
Amount of grassland on xeric sites (Acres)	264		264	264	264	264		264	264	264	264
(Rating)	VG		VG	VG	VG	VG		VG	VG	VG	VG
Amount of grassland on dry sites (Acres)	2,312		2,312	2,312	2,312	2,312		2,312	2,312	2,312	2,312
(Rating)	G		G	G	G	G		G	G	G	G
Amount of grassland on dry-mesic sites (Acres)	2,205		2,205	2,205	2,205	2,205		2,205	2,205	2,205	2,205
(Rating)	G		G	G	G	G		G	G	G	G
Amount of grassland on mesic sites (Acres)	576		576	826	826	976		576	676	676	726
(Rating)	VG		VG	VG	VG	VG		VG	VG	VG	VG

Table 3.2.5D - (Continued) **Grassland** indicator levels and ratings (VG=very good, G=good, F=fair, and P=poor) for current conditions and 10- and 50-year future conditions under Area Plan Alternatives W, X, Y, and Z for Land Between The Lakes, 2004.

			Indicator Level								
Key Factor	**Current**		**10 Years**					**50 Years**			
(Indicator)			**W**	**X**	**Y**	**Z**		**W**	**X**	**Y**	**Z**
Amount of grassland on riparian sites (Acres)	1,165		1,165	2,015	2,015	2,465		1,165	1,565	1,565	1,765
(Rating)	VG		VG	VG	VG	VG		VG	VG	VG	VG
Amount of canebrake (Acres)	0		0	50	50	50		0	240	240	240
(Rating)	P		P	P	P	P		P	G	G	G

The indicator levels and ratings in Table 3.2.5D were derived from Table 3.2.5B, the expected acreage of grassland for the 10- and 50-year periods in each alternative.

The overall abundance of grassland increases for all of the alternatives except W in 10 and 50 years even though the rating does not change except for Alternative Z in 50 years. Compared to the other alternatives, there is a higher increase of total grassland in Alternative Z for the 10-year period, due to overall reduced levels of open land management. As a result, more cultivated opening acreage would be converted to grassland. Through the implementation of a standard for riparian corridors, it is projected that a portion of current acres in cultivation will be converted to grassland in the first 10 years. During the next four decades, there is a slight decrease in the amount of grassland acres for Alternatives X, Y, and Z, due to grassland in riparian corridors converting to forest. The current levels of grassland on all site types are already good or very good and these levels are projected to be retained.

Currently we have approximately 600 acres in native grasses. In the first decade we intend to convert another 1000 acres in alternative W, another 500 acres in Alternative Z, and 750 acres in alternatives X and Y. In 50 years, no more than 2,600 acres are projected to be converted for all alternatives. The acreages projected for conversion of existing grassland to native grasses are based on the use of approved herbicide applications. See Canebrake under 3.2.6 for the discussion of effects to this rare community type.

Management Indicator Species

The Eastern meadowlark (*Sternella magna*) has been selected as an indicator to represent the conditions associated with preferred short to medium height grasses of the grassland community. This species favors somewhat taller grasses (up to 2 feet high, .6m) for nesting rather than foraging (Hamel, 1992). This species nests on the ground in concealing herbage and has avoided recently burned grassland habitats (NatureServe 2004). Based on Table 3.2.5D, there is little to no change for Alternatives W, X, and Y in 10 and 50 years (Table 3.2.5E). In Alternative Z, there would be an increase in the amount of additional acres as a result of cultivated open land being converted to grassland in the first decade. In 50 years, there would be a slight decrease in acres of grassland compared to the first decade due to grassland converting to forest.

Table 3.2.5E - Expected population trend[1] of Eastern meadowlark on LBL under each alternative for 10 and 50 years following plan adoption. Population trend estimates are based on expected trends in habitat quantity and quality.

Time Period	Alternative			
	W	X	Y	Z
10 years	=	=	=	+
50 years	=	=	=	-

[1]Population trend expressed as expected change from current levels: "++" = relatively large increase, "+" = increase, "=" = little to no change, "-" = decrease, "- -" = relatively large decrease.

The Northern bobwhite quail (*Colinus virginianus*) was selected as an indicator to represent the habitat conditions in the grassland and cultivated community types that include brushy areas and thickets, tall herbs, grasses, and saplings (e.g. old field and hedgerows bordering cropland and woodlands) (Hamel, 1992 and NatureServe, 2004). Nesting occurs in dense grass or other thick cover (Hamel, 1992). The expected population trend for this species would be dependent upon the habitat conditions present in the grassland, cultivated community types, and woodlands.

The expected population trends for this species, based on Table 3.2.4H for woodlands and Table 3.2.5C for grassland and cultivated, indicate no change in Alternative W in 10 and 50 years (Table 3.2.5F). In 10 years, there would be an increase in the amount of habitat available for the bobwhite in Alternatives X, Y, and Z as grassland open lands are retained, and increased slightly as openings in cultivation are converted to grassland and woodland habitat is created. In 50 years, there would be a relatively large increase in habitat for this species for Alternatives X, Y, and Z even with relatively less management prescribed for open lands and woodlands in Alternative Z.

Table 3.2.5F - Expected population trend[1] of Northern bobwhite quail on LBL under each alternative for 10 and 50 years following plan adoption. Population trend estimates are based on expected trends in habitat quantity and quality.

Time Period	Alternative			
	W	X	Y	Z
10 years	=	+	+	+
50 years	=	++	++	++

[1]Population trend expressed as expected change from current levels: "++" = relatively large increase, "+" = increase, "=" = little to no change, "-" = decrease, "- -" = relatively large descrease.

3.2.6 Rare Communities

Calcareous Cliffs and Talus

Affected Environment

There are a small number of calcareous cliffs and talus communities occurring on LBL. This type corresponds to CES202.690 Central Interior Calcareous Cliff and Talus (NatureServe, 2003). It may have Virginia pine associated (Chester, 2003).

Environmental Effects

This rare community type will be protected from negative impacts in each alternative where management or other potentially damaging activities are planned.

Canebrakes

Affected Environment

Canebrakes are characterized by almost monotypic stands of giant or switch cane *(Arundinaria gigantea),* usually with no or low densities of overstory tree canopy. They are typically found on alluvial sites or mesic stream terraces. They correspond to the Floodplain Canebrake Vegetation Association (CEGL003836) of the South-Central Interior Small Stream and Riparian Ecological System (CES202.706) (NatureServe 2003). Currently cane is found commonly as an understory component on many sites, provisions of the Rare Community prescription apply only to larger patches (generally greater than 0.25 acres) and exhibit high densities that result in monotypic conditions where it would occur naturally or to areas selected for restoration of such conditions. The patch condition as described is rare to nonexistent. The canebrakes that exist in LBL are remnant populations and they are generally small in number and size and scattered across LBL. Primary management needs are restoration and maintenance through overstory reduction and periodic prescribed fire.

Environmental Effects

Table 3.2.6A - Key Factors, Indicators, and Thresholds for the Conservation Target: **Canebrakes**

Key Factor	Indicator	Optimal	Very Good is >	Good is >	Fair is >	Poor is <
Amount of habitat for Canebrake Associates	Acres of habitat for Canebrake Associates	321	305	225	144	144

Table 3.2.6B - Canebrake indicator levels and ratings VG=Very good, G=good, F=fair, and P=poor) for current conditions and 10- and 50-year future conditions under Plan Alternatives W, X, Y, and Z for Land Between The Lakes, 2004.

	Indicator Level									
		10 Yrs					50 Yrs			
	Current	W	X	Y	Z		W	X	Y	Z
Amount of habitat for Canebrake Associates (Acres)	0	0	50	50	50		0	240	240	240
(Rating)	P	P	P	P	P		P	G	G	G

In the first decade we plan to provide 50 acres of canebrake in all of the alternatives except W, which does not have an objective to provide for this rare community type. In 50 years this rare community will have improved its rating to good, compared to poor currently. This species is being recognized as a floodplain species, thus the anticipated area of greatest potential is on alluvial site types.

Species associated with this cover type will be positively affected in the long term as management for this rare community type increases over the next 50 years. The canebrakes will be managed primarily outside of Riparian and Mesophytic Forest conditions. Canebrakes are restored through plantings and regenerating remnant populations within their existing location. The progress in restoring the desired conditions of canebrake would be monitored for size and density.

Springs and Seeps

Affected Environment

Springs are defined as the immediate area surrounding emergence of groundwater flow or seepage, which are characterized by soils that are permanently or seasonally saturated and there is a presence of hydric plant communities. Seeps that are characterized by flow that is insufficient to support characteristic vegetation are not included. This type may include the Cumberland Forested Acid Seep (CEGL007443), Interior Forested Acid Seep (CEGL004425), Midwest Sand Seep (CEGL002392), and Midwest Acid Seep (CEGL002263) Vegetation Associations of the South-Central Interior Small Stream and Riparian Ecological System (CES202.706) (NatureServe, 2003). According to TVA's 1994 Plan, there have been surveys done that looked at the types of springs in LBL. Survey results of a 1969 survey identified four types of springs, 131 springs; 19 free-flowing; 29 trickle-flowing; 34 seep; and 49 seasonal springs. LBL's largest free-flowing spring is Lost Creek Spring. Lingle-Gillis and Hamilton (1990) describe this spring as a temperate, calcarious with an average temperature of 58 degrees Fahrenheit and a discharge volume of 14,100 cubic feet per hour. There were 90 species of aquatic invertebrates found in this spring.

Hamilton *et. al.,* 2002 states the following:

> "The unique physical and chemical characteristics of springs produce habitats where only adapted aquatic species exist. Thus aquatic communities associated with springs are often specialized and limited in distribution. Spring biota is often highly specialized and sometimes has endemic taxa and glacial relics. The taxa richness varied widely among ten springs sampled in 1989 in LBL. No single taxon was found in all ten springs. Four taxa were found in eight springs and seventy-five percent of the taxa were collected in three or fewer springs. A tentative assessment at the time showed that springs that were geographically closer were more similar, while those that were more distant were taxonomically less similar."

Environmental Effects

This rare community type will be protected from negative impacts in each alternative where management or other potentially damaging activities are planned.

Rocky Shores and Bars

Affected Environment

Rocky shores and bars are primarily stream-associated supporting characteristic communities of vegetation. This type may include the Rocky Bar and Shore (Alder - Yellowroot Type) (CEGL003895), Rocky Bar and Shore (Twisted Sedge Type) (CEGL004103), Spiderlily - Water-willow Rocky Shoals (CEGL004285) Water-willow Rocky Bar and Shore (CEGL004286), and Rocky Bar and Shore (Riverweed Type) (CEGL004331) Vegetation Associations of the South-Central Interior Small Stream and Riparian Ecological System (CES202.706) (NatureServe 2003). The current abundance of this rare community type is unknown.

Environmental Effects

These rare community types will be protected from indirect and direct negative impacts from management in LBL through implementation of Area Plan standards primarily for riparian corridors and soil erosion. These areas are associated with stream terraces and gravel bars within stream corridors.

Lakeshores and Mudflats

Affected Environment

The mudflats and lake shoreline areas as described in this section are within the 354 to 359 foot elevations. These areas surrounding LBL fall within the jurisdiction of the United States Army Corps of Engineers (USACE) and Tennessee Valley Authority (TVA). The USDA Forest Service manages all land acres above the summer pool elevation of 359 feet. The Forest Service will work in cooperatively with the USACE and TVA on projects that involve their jurisdictional boundaries.

Lakeshore makes up 96 percent of LBL's boundary (about 300 miles of lakeshore edge compared to 12 miles of private property edge). Kentucky Lake and Lake Barkley (218,000 total surface acres) are the last downstream impoundments on the Tennessee and Cumberland Rivers, respectively. The two lakes are connected near their dams at LBL's north end by Barkley Canal, a 1.75 mile navigation channel. The canal allows for an equal pool level for the two lake systems. Flood control and electricity are the major functions of these high dams that result in having the reservoirs. The pool levels for both lakes are gradually lowered from a normal summer elevation of 359 feet above sea level to a winter elevation of 354 feet above sea level. The time span for draw-down varies somewhat, but normally begins in late July and ends in November.

There are many acres of shoreline and former bottomlands and floodplains that are exposed by draw-down. Reservoir shoreline areas that are covered by water during much of the growing season and exposed during late summer, autumn, and into (sometimes through) winter are referred to as seasonally dewatered flats or mudflats. Such mudflats are prominent landscape features of reservoirs on lower sections of riverine systems, such as those in LBL, since floodplains were generally wider there before inundation than they were upstream (Baskin *et.al.,* 2002).

The five foot fluctuation zone for Kentucky Lake and Lake Barkley represents a biologically diverse zone. The most diverse plant communities are in back of embayments, notably mudflat wetland habitats. Sixty-five species of vascular plants were recorded from 30 such mudflats on Lake Barkley. Of these, 52 species were native and 13 were introduced species. Sixty-eight percent were annual plants. These fluctuation zone plants provide food for waterfowl during early spring and fall migrations.

Environmental Effects

The Forest Service will manage the resources within its jurisdiction that adjoin the lakeshores and mudflats as to not directly or indirectly adversely affect them under all alternatives.

Virginia Pine (*Pinus virginiana*)

Affected Environment

This rare community of native Virginia pine occurs on precipitous bluffs above the Tennessee River and it is only known from two locations in LBL. The larger of two known communities in Stewart County, Tennessee is on Cedar Bluff in the Rushing Creek area. The second site is located on top of Pine Bluff and south of Clay Bay. This community may possibly occur on other bluffs elsewhere in LBL. Virginia pine often grows in pure stands and usually as a pioneer species.

Environmental Effects

This rare community type will be protected from negative impacts in each alternative where management or other potentially damaging activities are planned.

Mountain-Laurel (*Kalmia latifolia*)

This primarily Appalachian species community is scattered along the Tennessee River drainage, and LBL is on the western edge of its range. Mountain-laurel is widely distributed, from New Brunswick to central Florida. It occurs primarily along the Appalachian Mountains, westward to Louisiana and northward into southern Ohio and Indiana. This species occupies dry to mesic sites on upper rocky slopes and mountainous areas. The largest community of this species in LBL occurs between Colson Hollow and Red Hollow in Stewart County, Tennessee. Other smaller and scattered sites of this community occur primarily in Tennessee compared to the Kentucky portion of LBL where there are fewer bluffs present.

Common trees associated include table mountain pine (*Pinus pungens*), pitch pine (*P. rigida*), Virginia pine (*P. virginia*), white pine (*P. strobus*), and red maple (*Acer rubrum*).

Environmental Effects

This rare community type will be protected from negative impacts in each alternative where management or other potentially damaging activities are planned.

3.2.7 Special Habitat Components

Snags, Den Trees, and Downed Wood

Affected Environment

Large woody debris (including branches, large logs, stumps, and root wads) is an important component of both aquatic and terrestrial habitats. It is important both structurally and as a source of energy. Large snags provide birds with nesting and feeding sites, singing perches, and as lookout posts for predators and prey (Howard and Allen, 1988). Bats roost and produce maternity colonies under exfoliating bark. Amphibians, reptiles, small mammals, and invertebrates utilize woody debris as cover. Animals use snags, logs, and stumps as denning sites. Turtles and snakes use logs in streams and overhanging branches for basking and sunning. Large woody debris in riparian areas is used as cover by amphibians, insects, and other invertebrates, and small mammals. Small mammals utilize logs as travel ways. Fungi and other decomposers of woody debris are key components of food webs. Rotting wood tends to absorb moisture during wet periods and release it in dry periods thus helping to maintain a cooler microclimate (Ernst and Brown, 1988; Knutson and Naef, 1997).

Within the stream system, downed wood from riparian trees and shrubs greatly influence channel morphology and aquatic ecology. By obstructing stream flow, large woody debris stores and distributes sediment and creates channel features, such as pools, riffles, and waterfalls. Wood also traps organic matter, which allows this material to be processed by instream organisms. Fish and insects occupy the pools and riffles created by the large woody debris, and riparian forest regeneration occurs on deposited sediment (Lassettre and Harris 2001). Den trees, defined as living trees with hollows or cavities inhabited by animals, also are a necessary habitat component for many species. They are used for nesting, roosting, and hibernating. Viability of the Southeastern myotis bat and Rafinesque's big-eared bat are tied to snags and hollow trees because of their use as roosts. Other species of potential viability concern associated with snags, downed wood, or den trees are listed in Table 3.2.8H.

Hunter (1990) states that little information is available on how much large woody material is sufficient to support associated species. He cites literature that reviews expert opinion on snags, with a recommendation of two to four snags per acre being a "reasonable target." Generally, for most dependent wildlife, the more snags the better for associated species.

Current abundance of den trees, snags, and downed wood on LBL are assumed to be below optimal as a result of the relatively young age of existing forests. Presence of species dependent on these components indicates at least a short term ability of current densities to support associated populations of wildlife. For analysis purposes, optimal conditions for these components are assumed to be present once old growth conditions are reached, because these components are produced by the decadent conditions characteristic of old growth. Currently, no old growth on LBL is known. Snags and downed wood also may be extremely abundant in forests affected by mortality events such as storms and insect and disease outbreaks. Such conditions are not currently widespread on LBL. Nevertheless, these habitat components are present on LBL at less than optimal levels within mature forests of all types. Currently, approximately 106,688 acres, or 62 percent of LBL, supports mature forests. The current abundance and wide distribution of mature forests likely compensates to some extent for the lack of optimal densities of these habitat elements relative to supporting associated species.

Environmental Effects

All alternatives would include a standard for the protection of existing snags and den trees, except where removal is needed for public or employee safety, control of insects or disease infestations, or for timber salvage in cases of significant events of tree mortality. Implementation of the standard for snags and den tree protection is expected to maximize the benefits of existing snags and den trees to associated wildlife until more optimal densities are reached as trees age. Downed wood, which is produced as snags decay and fall, is expected to follow trends in snag abundance.

Vegetation management activities, such as forest thinning using timber harvest or herbicide treatment, are expected to increase abundance of snags due to associated tree mortality. These activities are highest under Alternatives W, X, and Y. Prescribed fire, used most prevalently under Alternatives X and Y, would have mixed effects on snag and downed wood abundance, reducing it through burning of these components while creating it in some cases through tree mortality. Eventually, densities of these components would be less in regularly burned areas than in unburned areas. Overall, however, providing these habitat components in the long run is best achieved by providing a sustained supply of older forests and old growth forests.

Indicators used for assessing habitat abundance for the Snag, Den Tree, and Downed Wood Habitat Associations are the acreage of old growth forests and the acreage of mature forests (Table 3.2.7A). This analysis shows current conditions relative to old growth to be “poor” due to the current age of LBL forests, but improvement to “good” conditions in the long term under all alternatives due to aging of forests over time. In contrast, acreage of mature forests is currently rated as “very good” and will remain so over time under all alternatives. In combination, these measures indicate a currently acceptable but greatly improving condition, under all alternatives, for species associated with snags, den trees, and downed wood.

In summary, snag, den tree, and downed wood densities are currently not optimal, but plan standards under all alternatives will protect most available habitat until conditions are improved over time through the aging of forests.

Table 3.2.7A - Snags, Den Trees, and Downed Wood indicator levels and ratings VG=Very good, G=good, F=fair, and P=poor for current conditions and 10- and 50-year future conditions under Area Plan Alternatives W, X, Y, and Z for Land Between The Lakes, 2004.

	Indicator Level									
		10 Yrs					50 Yrs			
	Current	W	X	Y	Z		W	X	Y	Z
Acres of old growth forests	0	713	673	673	684		58,640	51,816	51,816	57,331
(Rating)	P	P	P	P	P		G	G	G	G
Acres of mature forests	106,688	108,094	106,226	106,226	107,876		132,828	123,288	123,288	131,538
(Rating)	VG	VG	VG	VG	VG		VG	VG	VG	VG

Management Indicator Species

Snags in Forested Situations

The pileated woodpecker *(Dryocopus pileatus*) has been selected as an indicator because it requires large snags for nesting and feeding. The occurrence of this species may be correlated with forested habitats with abundant large dead trees and fallen logs (Hamel, 1992), which also are used by other woodpeckers, owls, and numerous other birds, mammals, and amphibians. It requires large cavity trees for nesting, and forages on dead trees and downed logs across a variety of community types. This species is selected to help indicate the effects of management activities on the availability of forests with desired abundance of snags in forested situations. Its use as an indicator is limited by its wide-ranging habits, which causes it to be documented in forest types that are not particularly suitable. In correlation with Table 3.2.7A, the amount of potential habitat for this species would increase in the first decade and increase considerably over the 50 year period (Table 3.2.7B).

Table 3.2.7B - Expected population trend[1] of pileated woodpecker on LBL under each alternative for 10- and 50-years following Area Plan adoption. Population trend estimates are based on expected trends in habitat quantity and quality.

	Alternative			
Time Period	W	X	Y	Z
10 years	+	+	+	+
50 years	++	++	++	++

[1]Population trend expressed as expected change from current levels: “++” = relatively large increase, “+” = increase, “=” = little to no change, “-“ = decrease, “- -“ = relatively large descrease.

Snags in Open Forest Situations

The Eastern bluebird (*Sialia sialis*) nests in natural cavities in open or semi open country such as in woodland, forest edge, roadsides, and partly open situations with scattered trees (Hamel, 1992 and NatureServe, 2004). This species has been selected as an indicator to represent habitat conditions in open forest situations. Habitat potential for the Eastern bluebird will increase in abundance proportionately to the amount of old growth available in open forested conditions (Table 3.2.7C). These increases are expected to provide for increases in Eastern bluebird populations under all alternatives in the next 10 years and even larger increases in 50 years (Table 3.2.7D).

Table 3.2.7C - Amount of habitat for Forest Opening Generalists indicator levels and ratings VG=Very good, G=good, F=fair, and P=poor) for current conditions and 10- and 50-year future conditions under Area Plan Alternatives W, X, Y, and Z for Land Between The Lakes, 2004.

	Indicator Level									
	Current	10 Yrs					50 Yrs			
Acres of old growth forest	0	713	673	673	684		58,640	51,816	51,816	57,331
(Rating)	P	P	P	P	P		G	G	G	G
Acres of mature forest	106,688	108,094	106,226	106,226	107,876		132,828	123,288	123,288	131,538
(Rating)	VG	VG	VG	VG	VG		VG	VG	VG	VG
Amount of habitat for Forest Opening Generalists (Acres)	18,907	33,455	32,619	32,619	24,669		58,280	75,666	75,666	42,266
(Rating)	P	F	F	F	P		G	G	G	F

Table 3.2.7D Expected population trend[1] of Eastern bluebird on LBL under each alternative for 10 and 50 years following Area Plan adoption. Population trend estimates are based on expected trends in habitat quantity and quality.

	Alternative			
Time Period	W	X	Y	Z
10 years	+	+	+	+
50 years	++	++	++	++

[1]Population trend expressed as expected change from current levels: "++" = relatively large increase, "+" = increase, "=" = little to no change, "-" = decrease, "- -" = relatively large descrease.

Regenerating Forest Habitat

Affected Environment

Regenerating forests are important because they are highly productive in terms of forage, diversity of food sources, insect production, nesting and escape cover, and soft mast. Regenerating forests have the shortest lifespan (10 years) of any of the forest structural types, and are typically in short supply and declining on public lands and in the eastern United States (Thompson and DeGraff, 2001). Early successional forests are also not distributed regularly or randomly across the landscape (Lorimer, 2001). These habitats are important for some birds (prairie warbler, yellow-breasted chat, Swainson's warbler); key to deer and turkey; and sought by hunters, berry pickers, crafters, and herb gatherers for the wealth of opportunities they provide (Gobster, 2001). Many species commonly associated with mature forest conditions also use regenerating forests periodically, or depend upon it during some portion of their life cycle (Hunter *et. al.,* 2001).

Quality of regenerating forest habitats often vary between private and public lands. Objectives on LBL to provide for wildlife habitat needs, recreational activities, scenic integrity objectives, and water quality often result in greater vegetation structure retained in regenerating forests than in similar habitats on private lands. On private lands, more intensive management may simplify structure and composition, reducing habitat quality. For these reasons, conclusions regarding cumulative habitat availability from both private and national forest lands must be made with caution.

Tornados, fire, and pre-settlement cultural activities (Delcourt, 1987) were probably the major sources of disturbance events that created regenerating forests prior to European occupation. Less drastic perturbations such as insect or disease outbreaks, or defoliation (passenger pigeon roosts) were typically less extensive and cyclic but nonetheless provided a source of regenerating forest conditions. Natural disturbances, however, are unpredictable, episodic, and heterogeneous (Lorimer, 2001); influential at a landscape scale; and are neither uniform nor random in distribution. Anthropogenic disturbances occurred more frequently in floodplains along major rivers and in "hunting grounds."

Overall, landscape patterns more consistently contain a component of regenerating forests in places more "likely" to be susceptible to disturbances, i.e., south and west facing slopes, sandy or well drained soils, or in fire-adapted plant communities. Fire suppression, intensive agriculture resulting in massive soil losses, land use changes, and urban sprawl has drastically altered the variables that would perpetuate a landscape with a significant component of regenerating forests. With many species associated with early successional forests in the southeast in decline (Hunter *et. al.,* 2001), it is imperative that management actions include some provision for perpetuating regenerating forest conditions.

LBL currently supports 2,371 of regenerating forests of all types, which rates as "good" based on combined structural condition benchmarks for all forest types.

Environmental Effects

Because regenerating forests provide suitable structural conditions for only a short period (10 years), they must be continually created to sustain associated species. Therefore, projections of amounts available represent a snapshot in time reflecting a sustained level of habitat creation.

Levels of regenerating forest created through management action are expected to remain close to current conditions (rated "good") under Alternative W, increase to "very good" conditions under Alternatives X and Y, and decline to "fair" conditions under Alternative Z (Table 3.2.7E). These trends are similar for both 10- and 50-year projections.

Some natural disturbance events that create regenerating forests, such as tornados, will still occur on the LBL landscape. Their occurrence, however, is highly stochastic, resulting in potential booms and busts in availability of these habitats. When and where they occur, their effects would be used under all alternatives to help meet objectives for this structural condition. Occurrence of these disturbance events would reduce the need for creation of regenerating forests through management action. However, to better provide a sustained flow of these habitats, as well as a diversity of forest ages, regular creation of regenerating forests by management action is anticipated under all alternatives.

Table 3.2.7E - Amount of habitat for Regenerating Forest Associates indicator levels and ratings VG=Very good, G=good, F=fair, and P=poor) for current conditions and 10- and 50-year future conditions under Area Plan Alternatives W, X, Y, and Z for Land Between The Lakes, 2004.

	Indicator Level									
	Current	10 Yrs					50 Yrs			
		W	X	Y	Z		W	X	Y	Z
Amount of habitat for Regenerating Forest Associates (Acres)	2,535	3,352	5,400	5,400	3,750		3,532	5,450	5,450	3,800
(Rating)	F	F	VG	VG	G		F	VG	VG	G

Management Indicator Species

The yellow-breasted chat (*Icteria virens*) primary habitats include secondary growth generally in dry situations that are comprised of thickets, brushy areas, woodland undergrowth, forest regeneration, and overgrown fields (Hamel, 1992 and NatureServe 2004). The yellow-breasted chat has been selected as an indicator of forest regeneration habitat. Based on Table 3.2.7E, there is little change in the amount of potential regeneration habitat in 10 and 50 years in Alternative W. There is a slight increase in Alternative Z and a relatively large increase in Alternatives X and Y in 10 and 50 years (Table 3.2.7F). There is less forest regeneration management being proposed in Alternative Z thus not as great of an increase compared to Alternatives X and Y.

Table 3.2.7F - Expected population trend[1] of yellow-breasted chat on LBL under each alternative for 10 and 50 years following Area Plan adoption. Population trend estimates are based on expected trends in habitat quantity and quality.				
Time Period	Alternative			
	W	X	Y	Z
10 years	=	++	++	+
50 years	=	++	++	+

[1]Population trend expressed as expected change from current levels: "++" = relatively large increase, "+" = increase, "=" = little to no change, "-" = decrease, "- -" = relatively large descrease.

Forest Interior Bird Habitat

Habitat fragmentation is a key issue for viability of local populations of breeding birds that are associated with mature deciduous forest interiors (Robbins, 1979; Faaborg, 2003; and Rosenburg *et. al.,* 2003). These species are grouped for effects analysis due to their sensitivity to forest fragmentation and edge effects (Hamel 1992: Appendix G, G1-G2).

Numerous studies have documented that forest interior species may not successfully breed in small patches of otherwise suitable habitat due in large part to adverse effects of forest edge (Faaborg, 2003). These adverse affects may include high rates of nest predation (Gates and Geysel, 1978; Wilcove, 1985; Yahner and Scott, 1988) and increased brood parasitism by the brown-headed cowbird (Robinson *et. al.,* 1993; Primack, 1993; Yahner, 1988). However, characteristics of the surrounding landscape, such as percent forest cover and composition of nonforest habitats, determine the magnitude of local edge effects (Faaborg, 2003).

Findings of Robinson *et. al.* (1995) indicate that edge effects in large landscapes (approximately 75,000 acres) with at least 70-80 percent forest cover are small enough to allow interior bird populations to be productive and viable. As a general rule, parasitism levels of 25 percent or less, and daily nest predation rates of four percent or less, should give most forest interior species "at least a chance" (Robinson *et. al.,* 1995) of having self-sustaining local populations (see also May and Robinson, 1985; Donovan *et. al.,* 1995). These conclusions are deemed to generally hold across the eastern United States based on a review of nest productivity studies (Faaborg, 2003).

The type of land use creating the opening may also affect the severity of edge effects. Agriculture, pasture, and urban/suburban edges are generally more detrimental to forest interior birds because they support higher populations of nest predators (raccoons, skunks, opossums, crows, and jays) and brown-headed cowbirds, a nest parasite, than do early successional forest edges. Duguay *et. al.* (2001) found that in a forested setting in West Virginia (Monongahela National Forest with greater than 88 percent forest cover) "fifteen years after harvest, cuts placed within otherwise extensively forested areas do not result in the type of edge effects (population sinks) observed in areas fragmented by agriculture in the midwestern United States." They also concluded that implementing relatively small cuts that create an edge on a small proportion of the landscape may not result in increased nest failure, provided that other factors such as proximity to cowbird feeding sites are not prominent. The study involved tracking 556 nests of 46 species over a four-year period and calculation of daily nest survival rates.

Recent research has shown that some edge in forested settings is even beneficial to forest interior birds (Faaborg, 2003; Rosenburg *et. al.,* 2003). Vega Rivera (1998) and Anders *et. al.* (1998) found that after fledging, juvenile wood thrushes disperse from mature forest habitats and enter early successional forests where they fed on invertebrates and fruit. Use of these habitats was very high relative to their availability. Later in the season, they shifted back into mature forest habitats. Fledglings preferred areas with dense understory and ground cover with species such as blackberry, sumac, and grape. Such areas may be provided by relatively small even-aged regeneration areas or by smaller dispersed canopy gaps (Rosenburg *et. al.,* 2003). Scattered canopy gaps and associated dense understories likely were characteristic of old growth mesic deciduous forests, providing optimal habitat for these species.

A study of cowbirds on LBL indicates they are common and associated with maintained openings (Miles, 1995). Nest parasitism rates averaged 23.6 percent, which is near the threshold level of 25 percent identified by Robinson *et. al.* (1995). Two species with sufficient sample size (northern cardinal and wood thrush) exceeded this level, and forest interior species were parasitized at a higher rate (30.5 percent) than edge or open habitat species. These results are not extreme, but warrant caution if management actions should cause substantive decreases in forest cover, or increases in edge and maintained openings favored by cowbirds.

Based on the research by Robinson *et. al.* (1995) and the review by Faaborg (2003), the percent on forest cover within LBL boundaries was chosen as an indicator of interior forest bird habitat. Thresholds were set based on this research, with 70 percent used to separate “good” and “fair” outcomes (Table 3.2.7G). Although regenerating forest creates edge that is less harmful than other land uses, it was subtracted from forest acreage during forest cover calculations to provide a conservative estimate of percent forest cover. Woodland has some characteristics of nonforest and some of forest. Because the response of nest predators and parasites to woodland conditions is uncertain, forest cover calculations were made both with and without woodland included as forest cover to allow consideration of effects from either perspective.

Currently, more than 90 percent of LBL is in forest cover, with or without woodland included, indicating a “very good” condition for forest interior associates (Table 3.2.7H). A more sophisticated GIS analysis using satellite imagery of land cover and a “roving window” of 75,000 acres was used to assess the landscape context of LBL lands (unpublished analysis by Andy Peavy, Inventory and Monitoring Institute, USDA Forest Service). This analysis indicates that all of LBL is within a landscape context with greater than 70 percent forest cover. Although surrounding private lands are severely fragmented, LBL, by virtue of its own forests, currently provides abundant mature deciduous forest habitat within a predominately forested landscape. In addition, the presence of large lakes surrounding LBL may reduce to some extent the effect of these fragmented private lands to forest interior nesting birds on LBL, by impeding the influx of nest predators, and potentially even cowbirds. However, the "very good" indicator rating is tempered by research results of Miles (1995), which indicate a more marginal situation, at least in terms of cowbird parasitism. Some influences within LBL, such as the presence of campgrounds, administrative areas, cultivated lands, hayfields, maintained open lands, and bison and elk prairies, likely enhance populations of nest predators and cowbirds. In addition, LBL is a relatively narrow peninsula of forested landscape surrounded by large areas of relatively hostile habitat for interior birds.

Environmental Effects

Under all alternatives within the next 10 years, percent forest cover declines slightly, dropping the indicator rating just below the "very good" threshold (90 percent) into the "good" range (Table 3.2.7H). Counting woodland as forest, this drop is very slight and is a result of slightly increased rates of forest regeneration under all alternatives. Over 50 years, these numbers rebound slightly for Alternatives X, Y, and Z as a result of conversion of some cultivated land to forest. This conversion is greatest under Alternative Z, taking the indicator back over the 90 percent threshold to a "very good" condition. Counting woodland as non-forest reduces the percent forest cover further for Alternatives X, Y, and Z, but still leaves them high within the "good" range within the next 10 years. These reductions in forest cover become more pronounced over 50 years as more acreage is restored to woodland structure, but in all cases the indicator remains above the 70 percent threshold, below which conditions would be rated only as "fair."

Interpretation of these results depends substantially on the role of restored woodlands in supporting higher populations of nest predators and cowbirds that would affect forest interior birds in surrounding habitats. Because quality woodlands are relatively rare today, especially distributed across a landscape in anything approximating a native condition, more complex interactions such as this have not been well studied. Because woodland conditions are expected to be restored in larger patches with variable residual tree density and "soft" indistinct edges, one might expect them not to concentrate adverse edge effects as do more typical permanent forest openings. Regardless of their potential for adverse effects to forest interior birds, woodlands are viewed as a critical habitat component for many grassland associated birds, which also are of high conservation concern. Their restoration is the focus of one of five habitat objectives identified in the Partners in Flight Bird Conservation Plan for the Interior Low Plateaus (Ford *et. al*., 2000) the physiographic region that includes LBL. Determining the effects of landscape-level restoration of oak woodland on forest interior birds is a research need.

Cumulatively, forest interior bird habitat on surrounding lands, and within the ecoregion in general is expected to remain fragmented and of low quality because of adverse edge effects. This fact makes maintaining quality habitat on LBL important to sustaining populations of forest interior birds within the region. The same can be said, however, for quality grassland and woodland habitats. The most desirable outcome for bird conservation as a whole involves some mix of forest interior and woodland/grassland habitats. Alternatives X, Y, and Z provide mixes estimated to support viable populations of woodland/grassland and forest interior birds. Within this range, Alternatives X and Y provide a larger emphasis on woodland and grassland habitats.

Table 3.2.7G - Key Factors, Indicators, and Thresholds for the Conservation Target: **Forest Interior Associates**

Key Factor	Indicator	Optimal	Very Good is >	Good is >	Fair is >	Poor is <
Forest Interior Associates	Percent of LBL landscape in forested condition	100%	90%	70%	50%	50%

Table 3.2.7H - Interior Forest indicator levels and ratings VG=very good, G=good, F=fair, and P=poor) for current conditions and 10- and 50 year future conditions under Area Plan Alternatives W, X, Y, and Z for Land Between The Lakes, 2004.

	Indicator Level										
		10 Yrs					50 Yrs				
	Current	W	X	Y	Z		W	X	Y	Z
Forest Interior Associates (% forest , including woodlands)	90.2%	89.8%	88.7%	88.7%	89.6%		89.8%	89.0%	89.0%	90.2%
(Rating)	VG	G	G	G	G		G	G	G	G
Forest Interior Associates (% forest , excluding woodlands)	90.2%	89.8%	85.1%	85.1%	87.8%		89.8%	71.4%	71.4%	81.2%
(Rating)	VG	G	G	G	G		G	G	G	G

Management Indicator Species

In addition to its selection as indicator species for mature mesophytic and riparian forests with complex structures, the wood thrush has been selected as indicator species for forest interior birds because of its association with mature deciduous forest interiors, and its apparent susceptibility to cowbird nest parasitism on LBL (Miles, 1995). This species is identified as a conservation priority species for mesophytic and oak-hickory forest types in this physiographic region (Ford *et. al*., 2000) and it has been touted as a good indicator of a forest's ability to support healthy bird populations (Rosenburg *et. al.,* 2003). It replaces the ovenbird, identified as an MIS for this group in the Draft EIS, because further literature review indicates it is not a conservation priority species, and it did not figure prominently in baseline research on fragmentation effects on interior bird productivity on LBL (Miles, 1995).

Assessment of effects of alternatives on wood thrush populations requires combining trends of habitat indicators for each of the relevant habitat elements. Currently the amount of mature mesophytic and miparian Forests with complex structures is rated as "poor" and is expected to remain that way over the next 10 years, despite some management efforts to create canopy gaps in these types under Alternatives X, Y, and Z (Tables 3.2.4M and 3.2.4R). At 50 years, the amount of Mesophytic Forests with complex structures is still poor across all alternatives, but the amount of Riparian Forest with complex structure improves to "good" for Alternatives X and Y, and "fair" for Alternative Z. Differences reflect level of management emphasis placed on creating canopy gaps to encourage complex structures. Assumptions used in this analysis very likely underestimate the status of these habitats because current and future creation of complex structures by natural causes are not estimated. They will, however, be inventoried and acknowledged during plan implementation, and therefore should be reflected in monitoring results, as well as in justifications for project-level proposals.

Another measure of available habitat is provided by analysis for the Mesic Closed Forest Habitat Association, which includes both Mature Closed Forest and Mature Forest with Canopy Gap structures. Conditions for this association are currently rated as "fair" with improvement to "good" over 50 years for all alternatives except Z which reaches "very good" (Table 3.2.8J). Improvements in this indicator occur as a result of aging of mesic forests and emphasis on retaining them while improving structure on a subset of that acreage.

Combining these indicators with the percent forest cover indicator (3.2.7H) presents a mixed picture for the wood thrush. Compared to current conditions, Alternative W would maintain the most forest cover but would not contribute to complex structures above background levels. Alternatives X and Y do the most for complex structures, but also involve the most woodland restoration which may have adverse affects on predation and nest parasitism in nearby interior habitats. Alternative Z involves levels of canopy gap and woodland restoration treatments between the other two outcomes. Similarly, both positive and potentially negative effects increase over time. For these reasons, management effects to wood thrush populations are estimated to be neutral across all alternatives (Table 3.2.7I). This conclusion is influenced by the uncertainty surrounding the effects of woodland restoration on landscape context for forest interior birds which is identified above as a research need.

Cumulatively, wood thrush populations across their range are declining, but show more stability within the region encompassing LBL (Sauer *et. al.,* 2004). Effects of management on LBL on wood thrush populations may be difficult to separate from those caused by land uses within the larger landscape (as described above) or those incurred during migration and wintering.

Table 3.2.7I - Expected population trend[1] of Wood Thrush on LBL under each alternative for 10 and 50 years following Area Plan adoption. Population trend estimates are based on expected trends in habitat quantity and quality.				
Time Period	Alternative			
	W	X	Y	Z
10 years	=	=	=	=
50 years	=	=	=	=
[1]Population trend expressed as expected change from current levels: "++" = relatively large increase, "+" = increase, "=" = little to no change, "-" = decrease, "- -" = relatively large descrease.				

3.2.8 Species of Viability Concern

The species of viability concern include Federally-listed, Regional Forester's Sensitive (RFS), Birds of Conservation Concern (BCC), and Locally rare species and communities.

As noted at the beginning of this section, the National Forest Management Act regulations, adopted in 1982, require that habitat be managed to support viable populations of native and desirable non-native vertebrates within the planning area (36 CFR 219.19). USDA regulation 9500-004, adopted in 1983, reinforces the NFMA viability regulation by requiring that habitats on national forests be managed to support viable populations of native and desired non-native plants, fish, and wildlife. These regulations focus on the role of habitat management in providing for species viability. Supporting viable populations involves providing habitat in amounts and distributions that can support interacting populations at levels that result in continued existence of the species well-distributed over time.

Viability Evaluation

The global rank, federal and state status, Regional Forester's Sensitive listing, state ranking and local ranking as defined below were determined for 101 species (Table 3.2.8A thru 3.2.8F) that occur or have the potential to occur within Land Between The Lakes due to existing and potential habitat. The state status and ranking and local (LBL) ranking were considered for both Kentucky and Tennessee. The area of consideration for state and locally rare species in the Table 3.2.8 series are those where the state listed species were recorded on 1:24,000 scale topographical quadrangles that cover LBL. The Grand Rivers quadrangle was not used as very little LBL topography is included on this quadrangle. Kentucky and Tennessee State Natural Heritage databases; NatureServe database, recent survey records and research documents, and expert opinion were used in developing the species list for LBL.

G-RANK - Estimate of element abundance on a global scale:

G1 = Extremely rare; **G2** = Rare; **G3** = Uncommon; **G4** = Common; and **G5** = Very Common; Subspecies and variety abundances are coded with a 'T' suffix; the 'G? portion of the rank then refers to the entire species.

<u>Status</u> – Federal and State

None = No status; **E =** Endangered; **T =** Threatened; **S =** Special Concern; **H =**Historic; **X =** Extirpated; and **D** = Declining and in need of management

Regional Forester's Sensitive Species

These are species assigned to a list developed by the Regional Forester in coordination with the Forests in the Region (LBL is in Region 8). They are all native and desired nonnative wildlife, fish, and plant species in habitats distributed throughout their geographic range on National Forest System lands that are in need of special management objectives and practices to maintain viable populations. The intent of the Regional Forester's sensitive species policy is to insure Forest Service actions do not result in a trend toward federal listing of sensitive species. These species are noted in Table 3.2.8A thru 3.2.8F as being a RFS species by yes (Y) or no (N).

Birds of Conservation Concern

The primary legal authority for *Birds of Conservation Concern 2002* (BCC, 2002) is the Fish and Wildlife Conservation Act of 1980 (FWCA), as amended; other authorities include the Endangered Species Act, the Fish and Wildlife Act of 1956, and 16 U.S.C.§701. The 1988 amendment (Public Law 100-653, Title VIII) to the FWCA requires the Secretary of the Interior, through the USFWS, to "identify species, subspecies, and populations of all migratory non-game birds that, without additional conservation actions, are likely to become candidates for listing under the Endangered Species Act of 1973." *BBC 2002* is the most recent effort by the USFWS to carry out this proactive conservation mandate. The species chosen are those from the Central Hardwoods BCC list that are known to breed in LBL.

<u>S-RANK</u>: Estimate of element occurrence abundance in Kentucky and Tennessee.

S1 = Extremely rare; **S2** = Rare; **S3** = Uncommon; **S4** = Many occurrences; **S5** = Very common; **SH** = Historically known in the state; **SR** = Reported but without persuasive documentation; and **S?** = State rank unknown

<u>Local (LBL) Forest Rank</u> - Estimate of element occurrence abundance in LBL for Kentucky and Tennessee.

F1 = Extremely Rare on the Forest Unit, generally with ***1-5 occurrences***;
F2 = Very rare on the Forest Unit, generally with ***6-20 occurrences***;
F3 = Rare and uncommon on the Forest Unit, from ***21-100 occurrences***;
F4 = Widespread, abundant, and apparently secure on the Forest Unit;
F5 = Demonstrably secure on the Forest Unit;
FH = Of historical occurrence on the Forest Unit, may be rediscovered;
FP = Possibly could occur on the Forest Unit but documented occurrences not known;
FX = Extirpated from the Forest Unit, not likely to be rediscovered.

Table 3.2.8A - Federally listed, Regional Forester's Sensitive and Locally Rare Plants						
Scientific Name/ (Common Name)	**G-Rank**	**Federal Status**	**RFS Species Y/N**	**KY Status/ S-Rank**	**TN Status/ S-Rank**	**LBL (F-Rank)**
Aesculus pavia (Red buckeye)	G5	None	N	T/S2S3	-/SR	**(F1)**
Agalinis obtusifolia (Ten-lobe false foxglove)	G4G5	None	N	E/S1	-/SR	**(F1)**
Apios priceana (Price's potato bean)	G2	T	N	E/S1	E/S2	**(F1)**
Aristida ramosissima (Branched three-awn grass)	G5	None	N	H/SH	E/SH	**(F1)**
Armoracia lacustris (Lakecress)	G4?	None	N	T/S1S2	S/S2	**(F2)**
Asclepias purpurascens (Purple Milkweed)	G4G5	None	N	-/S4	S/S1	**(F1)**
Aster concolor (Eastern silvery aster)	G4?	None	N	T/S2	-/SR	**(FP)**
Aster drummondii var. texanus (Texas aster)	G5T?	None	N	T/S2SH	(None)	**(FP)**
Aster (Eurybia) hemisphericus (Southern prairie aster)	G4T4?	None	N	E/S1	-/SR	**(F3)**
Aureolaria patula (Spreading yellow false foxglove)	G3	None	Y	S/S3	T/S2	**(F1)**
Baptisia bracteata var. leucophaea (Cream wild indigo)	G4G5T4 T5	None	N	S/S3	S/S1S2	**(F3)**
Carex comosa (Bristly sedge)	G5	None	N	H/SH	T/S2	**(F1)**
Carex lacustris (Lake-bank sedge)	G5	None	N	(None)	T/S1	**(F1)**
Carex reniformis (Reniform sedge)	G4?	None	N	E/S1?	S/S1	**(FP)**
Castanea dentate (American chestnut)	G4	None	N	E/S1?	S/S2?	**(F2)**
Cimicifuga rubifolia (Appalachian bugbane)	G3	None	Y	T/S2	T/S3	**(F1)**
Dalea candida (White prairie clover)	G5	None	N	-/S3S4	E/S2	**(F1)**

Table 3.2.8A (Continued)						
Scientific Name/ (Common Name)	**G-Rank**	**Federal Status**	**RFS Species Y/N**	**KY Status/ S-Rank**	**TN Status/ S-Rank**	**LBL (F-Rank)**
Echinacea pallida (Pale-purple coneflower)	G4	None	N	(None)	T/S1	**(F1)**
Eleocharis intermedia (Matted spike-rush)	G5	None	N	-/SR	S/S1	**(F1)**
Glandularia canadensis (Rose mock vervain)	G5	None	N	T/S2S3	-/SR	**(F1)**
Gymnopogon ambiguous (Bearded Skeletongrass)	G4	None	N	S/S2S3	-/SR	**(F1)**
Halesia tetraptera (Mountain silver-bell)	G5	None	N	E/S1S2	-/S4	**(F3)**
Hedeoma hispida (Rough pennyroyal)	G5	None	N	T/S2	-/SR	**(F1)**
Heteranthera dubia (Grassleaf mud-plantain)	G5	None	N	S/S3	-/SR	**(F1)**
Heteranthera limosa (Blue mud-plantain)	G5	None	N	S/S2S3	T/S1	**(F1)**
Hieracium longipilum (Hairy hawkweed)	G4G5	None	N	T/S2	S/S1S2	**(FP)**
Hottonia inflate (Featherfoil)	G4	None	N	-/S4?	S/S2	**(F1)**
Iris brevicaulis (Lamance iris)	G4	None	N	-/S?	E/S1	**(F1)**
Juglans cinerea (Butternut)	G3G4	None	Y	S/S3	T/S2S3	**(F2)**
Lesquerella lescurii (Lescur's bladder-pod)	G4	None	N	S/S1	-/S3	**(F1)**
Lilium michiganense (Michigan lily)	G5	None	N	-/S?	T/S2	**(F2)**
Lilium superbum (Turk's Cap lily)	G5	None	N	T/S1S2	-/SR	**(FP)**
Liparis loeselli (Fen orchis)	G5	None	N	T/S2S3	E/S1	**(F1)**
Lysimachia fraseri (Fraser's yellow loosestrife)	G2	None	Y	E/S1	E/S2	**(FH)**
Malus angustifolia (Southern crabapple)	G5?	None	N	S/S3	-/SR	**(F2)**
Matelea carolinensis (Carolina anglepod)	G4	None	N	E/S1?	-/SR	**(F1)**
Muhlenbergia glabrifloris (Hair grass)	G4?	None	N	S/S2S3	S/S1	**(F1)**

Table 3.2.8A (Continued)						
Scientific Name/ (Common Name)	**G-Rank**	**Federal Status**	**RFS Species Y/N**	**KY Status/ S-Rank**	**TN Status/ S-Rank**	**LBL (F-Rank)**
Najas gracillima (Thread-like naiad)	G5?	None	N	S/S2S3	-/SR	**(F1)**
Nemophila aphylla (Baby blue eyes)	G5	None	N	T/S2?	-/SR	**(F1)**
Oldenlandia uniflora (Clustered bluets)	G5	None	N	E/S1	-/SR	**(F1)**
Paspalum boscianum (Bull-grass)	G5	None	N	S/S2S3	-/S4	**(FH)**
Phacelia ranunculacea (Ocean-blue phacelia)	G3G4	None	Y	S/S3	S/S3	**(F1)**
Philadelphus inodorus (Mock orange)	G4G5	None	N	T/S1S2	-/S4S5	**(F1)**
Phlox pilosa ssp. Ozarkana (Ozark downy phlox)	G5T?	None	N	(None)	S/S1	**(FP)**
Polytaenia nuttallii (Prairie parsley)	G5	None	N	PE/?S	T/S1	**(FH)**
Populus grandidentata (Big-tooth aspen)	G5	None	N	-/S?	S/S2	**(F1)**
Prenanthes barbata (Barbed rattlesnake-root)	G2	None	Y	E/S1	S/S2	**(F1)**
Prenanthes crepidinea (Nodding rattlesnake-root)	G3G4	None	N	T/S2	E/S1	**(F1)**
Ptilimnium capillaceum (Mock Bishop's weed)	G5	None	N	T/S1S2	-/SR	**(F2)**
Ptilimnium nuttallii (Nuttall's Mock (Bishop's weed)	G5?	None	N	E/S1S2	-/SR	**(F2)**
Pycnanthemum albescens (Whiteleaf mountainmint)	G5	None	N	E/S1	(None)	**(FP)**
Ranunculus flabellaris (Yellow watercrowfoot)	G5	None	N	-/S?	T/S2	**(F1)**

Table 3.2.8A (Continued)						
Scientific Name/ (Common Name)	**G-Rank**	**Federal Status**	**RFS Specie Y/N**	**KY Status/ S-Rank**	**TN Status/ S-Rank**	**LBL (F-Rank)**
Sagittaria brevirostra (Short-beaked arrowhead)	G5	None	N	-/S4	T/S1	**(F1)**
Sagittaria graminea (Grassleaf arrowhead)	G5	None	N	T/S1S2	T/S1	**(F1)**
Sagittaria platyphylla (Delta or Ovate-leaved arrowhead)	G5	None	N	T/S2?	S/S2S3	**(F1)**
Salvia azurea var grandiflora (Blue sage)	G4G5T4?	None	N	-/S?	S/S2	**(F3)**
Scleria ciliata var. ciliate (Fringed nutrush)	G5T?	None	N	E/S1?	-/S?	**(FP)**
Silphium pinnatifidum (Prairie-dock)	G3Q	None	N	S/S3S4	T/S2	**(F1)**
Solidago buckleyi (Buckley's goldenrod)	G4	None	N	S/S2S3	(None)	**(F1)**
Stellaria longifolia (Longleaf stitchwort)	G5	None	N	S/S2S3	E/S1	**(FP)**
Synosma (Hasteola) sauveolens (Sweet-scented or Indian plantain)	G3G4	None	Y	-/S?	T/S2	**(F1)**
Trepocarpus aethusae (Trepocarpus)	G4G5	None	N	T/S3	-/SR	**(F3)**
Trifolium reflexum (Buffalo clover)	G5	None	N	E/S1S2	E/S1	**(F1)**
Ulmus serotina (September elm)	G4	None	N	S/S3	-/S3S4	**(F1)**
Zanthoxylum americanum (American prickly ash)	G5	None	N	-/S?	S/S1	**(FH)**

Table 3.2.8B - Federally-listed Birds						
Common Name/ (Scientific Name)	**G-Rank**	**Federal Status**	**RFS Species Y/N**	**KY Status/ S-Rank**	**TN Status/ S-Rank**	**LBL (F-Rank)**
Bald eagle *(Haliaeetus leucocephalus)*	G4	T	N	E/S1S2B	D/S3	**(F3)**
Interior least tern *(Sterna antillarum athalassos)*	G4	E	N	E/S2B	E/S2S3B	**(FP)**

Table 3.2.8C - Locally Rare Birds and Birds of Conservation Concern						
Common Name/ (Scientific Name)	**G-Rank**	**Locally Rare Y/N**	**BCC Species Y/N**	**KY Status /S-Rank**	**TN Status /S-Rank**	**LBL (F-Rank)**
Sharp-shinned hawk *(Accipiter striatus)*	G5	Y	N	S/S3BS4N	D/S3B	**(F1)**
Henslow's sparrow *(Ammodramus henslowii)*	G4	Y	Y	S/S3B	D/S1B	**(F1)**
Whip-poor-will *(Caprimulgus vociferous)*	G5	N	Y	-/S5B	-/S3S4	**(F4)**
Northern bobwhite quail *(Colinus virginianus)*	G5	Y	N	-/S5	-/S2S3	**(F4)**
Cerulean warbler *(Dendroica cerulean)*	G4	Y	Y	-/S4S5B	D/S3B	**(F1)**
Prairie warbler (*Dendroica discolor*)	G5	N	Y	-/S5B	-/S3S4	**(F4)**
Little blue heron (*Egretta caerulea*)	G5	Y	N	E/S1B	D/S2BS3N	**(FP)**
Worm-eating warbler (*Helmitheros vermivorus*)	G5	N	Y	-/S4S5B	-/S4	**(F4)**
Wood thrush (*Hylocichla mustelina*)	G5	N	Y	-/S5B	-/S4	**(F4)**
Swainson's warbler (*Limnothlypis swainsonii)*	G4	N	Y	-/S3S4B	D/S3	**(FP)**

Table 3.2.8C (Continued)						
Common Name/ (Scientific Name)	**G-Rank**	**Locally Rare Y/N**	**BCC Species Y/N**	**KY Status /S-Rank**	**TN Status /S-Rank**	**LBL (F-Rank)**
Red-headed woodpecker (*Melanerpes erythrocephalus*)	G5	N	Y	-/S4BS4N	-/S4	**(F4)**
Black-crowned night heron (*Nycticorax nycticorax*)	G5	Y	N	T/S1S2B	-/S2S3B	**(FP)**
Osprey (*Pandion haliaetus*)	G5	Y	N	T/S1S2B	-/S3B	**(F2) Adjacent Large Lakes to LBL**
Louisiana waterthrush *(Seiurus motacilla)*	G5	N	Y	-/S5B	-/S4	**(F4)**
Bewick's wren *(Thryomanes bewickii)*	G5	Y	Y	S/S3B	E/S1	**(F1)**
Barn owl *(Tyto alba)*	G5	Y	N	S/S3	D/S3	**(FP)**
Blue-winged warbler *(Vermivora pinus)*	G5	N	Y	-/S4S5B	-/S4	**(F4)**

Table 3.2.8D - Federally-listed, Regional Forester's Sensitive and Locally Rare Mammals						
Common Name/ (Scientific Name)	**G-Rank**	**Federal Status**	**RFS Species Y/N**	**KY Status/ S-Rank**	**TN Status/ S-Rank**	**LBL (F-Rank)**
Gray bat *(Myotis grisescens)*	G3	E	N	E/S2	E/S2	**(F2)**
Indiana bat *(Myotis sodalis)*	G2	E	N	E/S1S2	E/S1	**(FP)**
Southeastern myotis bat *(Myotis austroriparius)*	G3G4	None	Y	E/S1S2	--/S3	**(FP)**
Rafinesque's big-eared bat *(Corynorhinus rafinesquii)*	G3G4	None	Y	S/S3	None	**(FP)**
Evening bat *(Nycticeius humeralis)*	G5	None	N	T/S2S3	None	**(F3)**
Pigmy Shrew *(Microsorex hoyi)*	G5	None	N	None	D/S2	**(FP)**

Table 3.2.8E - Locally Rare Amphibians and Reptiles				
Common Name/ (Scientific Name)	**G-Rank**	**KY Status /S-Rank**	**TN Status /S-Rank**	**LBL (F-Rank)**
Barking treefrog *(Hyla gratiosa)*	G5	S/S3	D/S3	**(FP)**
Southeastern five-lined skink *(Eumeces inexpectatus)*	G5	S/S3	-/S5	**(F3)**
Coal skink *Eumeces anthracinus)*	G5	T/S2	D/S3	**(FP)**
Scarlet kingsnake *(Lampropeltis triangulum elapsoides)*	G5T5	S/S3	None	**(F2)**
Alligator snapping turtle *(Macrochelys temminckii)*	G3G4	T/S2	D/S2S3	**(F2)**
Northern pine snake *(Pituophis melanoleucus melanoleucus)*	G4T4	T/S2	T/S3	**(F2)**
Eastern ribbon snake *(Thamnophis sauritus sauritus)*	G5	S/S3	-/S4S5	**(F3)**
Western pigmy rattlesnake *(Sistrurus miliarius streckeri)*	G5T5	T/S2	T/S2S3	**(F2)**

Table 3.2.8F - Locally Rare Fish				
Common Name/ (Scientific Name)	**G-Rank**	**KY Status/ S-Rank**	**TN Status/ S-Rank**	**LBL (F-Rank)**
Blotched chub *(Erimystax insignis)*	G3G4	E/S1	?/S3	**(FH)**
Spring cavefish *(Forbesichthys agassizi)*	G4	-/S4S5	-/S4	**(F3)**
Slender madtom *(Noturus exilis)*	G5	E/S1	-/S4S5	**(F2)**

Habitat Associations as defined in Table 3.2.8G were developed based on a single key limiting requirement and combinations of key limiting requirements for all the species of viability concern. The key limiting requirements for each species were linked to specific cover, structure, and site types. These links or groupings formed the Habitat Associations. The species of viability concern listed in Tables 3.2.8A thru 3.2.8F are linked to the habitat associations in Table 3.2.8H. Following the process described in Section 3.2.1, Key Factors, Indicators, and Thresholds for “very good”, “good”, “fair”, and “poor” conditions were identified for the Habitat Associations (Table 3.2.8I). Expected acreage outcomes were then rated according to these Thresholds (Table 3.2.8J).

Table 3.2.8G - Habitat Associations and Descriptions	
Association Name	**Association Description**
Upland Forest Associates	Species associated with all forest cover types on all site types except Alluvial sites.
Forest Opening Associates	Species associated with structural types of Mature Open Forest, Mature Forest with Gaps, Mature Woodland, and Regenerating Forests in all forest cover types
Xeric and Dry Open Forest Associates	Species associated with Oak Forest and Shortleaf Pine Forest with Mature Open Forest, Mature Woodland, and Regenerating Forest structures on Xeric and Dry sites
Mesic Forest Associates	Species associated with Mesophytic Forest, Riparian Forest of all structural types on all site types, plus Oak Forest on Mesic and Alluvial site types.
Mesic Closed Canopy Forest Associates	Species associated with Mesophytic Forest and Riparian Forest with Mature Closed Forest and Mature Forest with Gaps structures, plus Oak Forests on Mesic and Alluvial sites with Mature Closed Forest and Mature Forest with Gaps structures.
Mesic Forest Opening Associates	Species associated with Mesophytic Forest and Riparian Forest with Mature Open Forest, Mature Woodland, Mature Forest with Canopy Gaps, and Regenerating Forest structures on all site types, plus Oak Forests with Mature Open Forest, Mature Woodland, Mature Forest with Canopy Gaps, and Regenerating Forest on Mesic and Alluvial sites
Riparian Forest Associates	Species associated with Oak Forest, Mesophytic Forest, and Riparian Forest of all structural types on Alluvial sites
Riparian Forest Openings Associates	Species associated with Oak Forest, Mesophytic Forest, and Riparian Forest, with Mature Open Forest, Mature Woodland, Mature Forest with Canopy Gaps, and Regenerating Forest structures on Alluvial sites
Xeric and Dry Grassland and Woodland Associates	Species associated with Grasslands, and Oak Forests in Mature Woodland structure, on Xeric and Dry sites
Wet Grassland Associates	Species associated with Grasslands on Alluvial sites
Calcareous Cliffs and Talus Associates	Species associated with Calcareous Cliffs and Talus
Ponds and Marshes Associates	Species associated with Ponds and Marshes
Springs and Seeps	Species associated with Springs and Seeps
Rocky Shores and Bars Associates	Species associated with Rocky Shores and Bars
Mudflats Associates	Species associated with Mudflats

Table 3.2.8G (Continued)	
Limestone Soil Associates	Species associated with limestone soils
Stream Associates	Species associated with streams
Open Water Associates	Species associated with open water
Lakeshore Associates	Species associated with forested lakeshores
Pine Forest Associates	Species associated with Shortleaf Pine Forests and Planted Pine Forests of all structure and site types
Grassland Associates	Species associated with Grasslands on all site types
Canebrake Associates	Species associated with Canebrakes
Den Trees Associates	Species associated with den trees
Regenerating Forest Associates	Species associated with Regenerating Forest of all forest types and site types
Snag Associates	Species associated with standing dead trees
Downed Wood Associates	Species associated with large downed logs

Table 3.2.8H - Species of Viability Concern by Habitat Association. **Bolded** = Federally listed; *Italics* = Regional Forester's Sensitive; and * = Bird of Conservation Concern.

Upland Forest Associates
- American chestnut
- American prickly ash
- Scarlet kingsnake

Forest Opening Associates
- **Price's potato bean**
- *Fraser's yellow loosestrife*
- Southern crabapple
- Texas aster
- Sharp-shinned hawk
- Red-headed woodpecker*
- Bewick's wren*
- **Indiana bat**
- *Rafinesque's big-eared bat*
- Evening bat

Xeric and Dry Open Forest Associates
- Ten-lobe false foxglove
- Southern prairie aster
- *Spreading yellow false foxglove*
- Crème wild indigo
- Carolina anglepod
- Ozark downy phlox
- Big-tooth aspen
- *Barbed rattlesnake root*
- White-leaf mountain mint
- Fringed nutrush
- Buckley's goldenrod
- Buffalo clover
- Evening bat
- Northern pine snake

Xeric and Dry Grassland and Woodland Assoc.
- Branched three-awn grass
- Purple milkweed
- Eastern silvery aster
- Crème wild indigo
- Rose mock vervain
- Hairy hawkweed
- White prairie clover
- Hair grass
- Prairie parsley

Xeric and Dry Grassland and Woodland Associates (cont.)
- *Barbed rattlesnake root*
- Ozark downy phlox
- Blue sage
- Prairie-dock
- Buffalo clover
- Prairie warbler*
- Barn owl
- Northern bobwhite quail*
- Northern pine snake
- Southern five-lined skink

Pine Forest Associates
- Whip-poor-will*
- Sharp-shinned hawk
- Northern pine snake

Calcareous Cliffs and Talus Associates
- **Price's potato bean**
- *Spreading yellow false foxglove*
- *Appalachian bugbane*
- Pale purple coneflower
- Rose mock vervain
- Bearded skeleton-grass
- Rough pennyroyal
- Mock orange

Limestone Soil Associates
- *Appalachian bugbane*
- Rose mock vervain
- Rough pennyroyal
- Mock orange
- Nodding rattlesnake-root
- September elm

Interior Forest Associates
- Worm-eating warbler*
- Wood thrush*
- Cerulean warbler*
- Sharp-shinned hawk
- Whip-poor-will*
- Swainson's warbler*
- Louisiana waterthrush*

Mesic Forest Associates
Red buckeye
Appalachian bugbane
Mountain silver-bell
Butternut
Fen orchis
Baby blue eyes
September elm
Coal skink
Pigmy shrew

Mesic Closed Canopy Forest Associates
Ocean-blue phacelia
Worm-eating warbler*
Wood thrush *

Mesic Forest Opening Associates
Michigan lily
Turk's Cap lily
Nodding rattlesnake-root
Bigtooth aspen
Whip-poor-will*
Cerulean Warbler*
Wood thrush*

Riparian Forest Associates
Reniform sedge
Lamance iris
Louisiana waterthrush*
Eastern ribbon snake

Riparian Forest Opening Associates
Fraser's yellow loosestrife
Indian plantain
Longleaf stitchwort
Trepocarpus
Whip-poor-will*
Swainson's warbler
Cerulean warbler*
Black-crowned night heron
Gray bat
Indiana bat
Southeastern myotis bat
Rafinesque's big-eared bat

Riparian Forest Opening Assoc. (cont.)
Evening bat
Western pigmy rattlesnake
Barking treefrog

Regenerating Forest Associates
Blue-winged warbler*
Praire warbler*
Bewick's wren*
Northern pine snake

Canebrake Associates
Swainson's warbler

Den Tree Associates
Barn owl
Indiana bat
Southeastern myotis bat
Rafinesque's big-eared bat

Snag Associates
Indiana bat
Evening bat
Red-headed woodpecker*
Bewick's wren*
Osprey
Bald eagle

Downed Wood Associates
Southeastern five-lined skink
Coal skink
Scarlet kingsnake

Mudflat Associates
Grassleaf mud-plantain
Blue mud-plantain
Thread-like naiad
Little blue heron

Springs and Seeps Associates
Fen orchis
Spring cavefish

Table 3.2.8H (Continued)

Wet Grassland Associates
Fraser's yellow loosestrife
Lescur's bladder-pod
Bull-grass
Reniform sedge
Longleaf stitchwort
Henslow's sparrow*
Barn owl
Eastern ribbon snake
Western pigmy rattlesnake
Barking treefrog
Pigmy shrew

Lakeshores Associates
Bald eagle
Interior least tern
Black-crowned night heron
Osprey
Gray bat
Southeastern myotis bat
Western pigmy rattlesnake

Rocky Shores and Bars Associates
Lakecress
Lake-bank sedge
Matted spike-rush
Grassleaf mud-plantain
Blue mud-plantain
Featherfoil
Thread-like naiad
Clustered bluets
Mock Bishop's weed
Nutall's Mock Bishop's weed
Short-beaked arrowhead
Grassleaf arrowhead
Indian plantain

Ponds and Marshes Associates
Lakecress
Bristly sedge
Lake-bank sedge
Reniform sedge
Matted spike-rush
Grassleaf mud-plantain
Blue mud-plantain
Featherfoil
Lamance iris
Fen orchis
Thread-like naiad
Clustered bluets
Mock Bishop's weed
Short-beaked arrowhead
Grassleaf arrowhead
Delta-leaved arrowhead
Yellow watercrowfoot
Little blue heron
Black-crowned night heron
Gray bat
Indiana bat
Southeastern myotis bat
Barking treefrog
Western pigmy rattlesnake

Streams Associates
Little blue heron
Black-crowned night heron
Louisiana waterthrush*
Blotched chub
Slender madtom

Lakes (Water) Associates
Bald eagle
Osprey
Little blue heron
Alligator snapping turtle

See Appendix E (Table E.3) for Habitat Associations by Species of Viability Concern.

Table 3.2.8I - Key Factors, Indicators, and Thresholds for the Conservation Target: **Habitat Associations**

Key Factor	Indicator	Optimal Acres	Very Good is >	Good is >	Fair is >	Poor is <
Amount of habitat for Upland Forest Associates	Acres of habitat for Upland Forest Generalists	150,503	112,878	75,252	37,626	37,626
Amount of habitat for Forest Opening Associates	Acres of habitat for Forest Opening Generalists	116,559	87,419	58,279	29,140	29,140
Amount of habitat for Xeric and Dry Open Forest Associates	Acres of habitat for Dry and Xeric Open Forest Associates	59,861	44,896	29,931	14,965	14,965
Amount of habitat for Mesic Forest Associates	Acres of habitat for Mesic Forest Generalists	25,731	19,299	12,866	6,433	6,433
Amount of habitat for Mesic Closed Canopy Forest Associates	Acres of habitat for Mesic Closed Canopy Forest Associates	22,130	16,597	11,065	5,532	5,532
Amount of habitat for Mesic Forest Opening Associates	Acres of habitat for Mesic Forest Opening Associates	18,855	14,141	9,427	4,714	4,714
Amount of habitat for Riparian Forest Associates	Acres of habitat for Riparian Forest Generalists	10,264	8,724	6,158	3,592	3,592
Amount of habitat for Riparian Forest Openings Associates	Acres of habitat for Riparian Forest Openings Associates	6,980	5,933	4,188	2,443	2,443
Amount of habitat for Xeric and Dry Grassland and Woodland Associates	Acres of habitat for Dry and Xeric Grassland and Woodland Associates	34,428	25,821	17,214	8,607	8,607

Table 3.2.8I - (Continued) Key Factors, Indicators, and Thresholds for the Conservation Target: **Habitat Associations**

Key Factor	Indicator	Optimal Acres/ Percent	Very Good is >	Good is >	Fair is >	Poor is <
Amount of habitat for Wet Grassland Associates	Acres of habitat for Wet Grassland Associates	641	609	449	289	289
Amount of habitat for Ponds and Marshes Associates	Acres of habitat for Ponds and Marshes Associates	1,924	1,636	1,155	674	674
Amount of habitat for Pine Forest Associates	Acres of habitat for Pine Forest Associates	1,637	1,555	1,146	736	736
Amount of habitat for Grassland Associates	Acres of habitat for Grassland Generalist	8,563	7,278	5,138	2,997	2,997
Quality of habitat for Grassland Associates	Acres of grassland habitat dominated by native grasses	8,563	7,278	5,138	2,997	2,997
Amount of habitat for Canebrake Associates	Acres of habitat for Canebrake Associates	321	305	225	144	144
Amount of habitat for Den Trees Associates	Acres of habitat for Den Trees Associates	85,691	64,268	42,845	21,423	21,423
Amount of habitat for Regenerating Forest Associates	Acres of habitat for Regenerating Forest Associates	6,197	5,268	3,718	2,169	2,169
Snag Associates	Acres of habitat for Snag Associates	85,691	64,268	42,845	21,423	21,423
Downed Wood Associates	Acres of habitat for Downed Wood Associates	85,691	64,268	42,845	21,423	21,423
Forest Interior Associates	Percent of LBL landscape in forested condition	100%	90%	70%	50%	50%

Table 3.2.8J - Habitat Association indicator levels and ratings (VG=very good, G=good, F=fair, and P=poor) for current conditions and 10- and 50 year future conditions under Area Plan Alternatives W, X, Y, and Z for Land Between The Lakes, 2004.

			Indicator Level								
Key Factor	**Current**		**10 Years**					**50 Years**			
(Indicator)			**W**	**X**	**Y**	**Z**		**W**	**X**	**Y**	**Z**
Amount of habitat for Upland Forest Associates (Acres)	148,569		152,127	152,127	152,127	152,127		152,127	152,396	152,396	152,562
(Rating)	**VG**		VG	VG	VG	VG		VG	VG	VG	VG
Amount of habitat for Forest Opening Associates (Acres)	18,907		33,455	32,619	32,619	24,669		58,280	75,666	75,666	42,266
(Rating)	**P**		F	F	F	P		G	G	G	F
Amount of habitat for Xeric and Dry Open Forest Associates (Acres)	11,257		14,260	19,285	19,285	14,785		31,060	42,919	42,919	24,169
(Rating)	**P**		P	F	F	P		G	G	G	F
Amount of habitat for Mesic Forest Associates (Acres)	21,216		21,216	21,208	21,208	21,208		21,216	21,665	21,665	21,928
(Rating)	**VG**		VG	VG	VG	VG		VG	VG	VG	VG
Amount of habitat for Mesic Closed Canopy Forest Associates (Acres)	10,637		11,054	10,934	10,934	11,335		16,162	15,627	15,627	17,635
(Rating)	**F**		F	F	F	G		G	G	G	VG

Table 3.2.8J - (Continued) **Habitat Association** indicator levels and ratings (VG=very good, G=good, F=fair, and P=poor) for current conditions and 10- and 50 year future conditions under Area Plan Alternatives W, X, Y, and Z for Land Between The Lakes, 2004.

			Indicator Level								
Key Factor	**Current**		**10 Years**					**50 Years**			
(Indicator)			**W**	**X**	**Y**	**Z**		**W**	**X**	**Y**	**Z**
Amount of habitat for Mesic Forest Opening Associates (Acres)	1,293		1,997	2,660	2,660	1,977		1,427	7,182	7,182	3,947
(Rating)	**P**		P	P	P	P		P	F	F	P
Amount of habitat for Riparian Forest Associates (Acres)	8,394		8,394	8,391	8,391	8,391		8,394	8,724	8,724	8,913
(Rating)	**G**		G	G	G	G		G	VG	VG	VG
Amount of habitat for Riparian Forest Openings Associates (Acres)	265		736	993	993	723		557	3,174	3,174	1,759
(Rating)	**P**		P	P	P	P		P	F	F	P
Amount of habitat for Xeric and Dry Grassland and Woodland Associates (Acres)	2,576		2,576	8,576	8,576	5,576		2,576	32,576	32,576	17,876
(Rating)	**P**		P	P	P	P		P	VG	VG	G
Amount of habitat for Wet Grassland Associates (Acres)	1,165		1,165	2,015	2,015	2,465		1,165	1,565	1,565	1,765
(Rating)	**VG**		VG	VG	VG	VG		VG	VG	VG	G

Table 3.2.8J - (Continued) **Habitat Association** indicator levels and ratings (VG=very good, G=good, F=fair, and P=poor) for current conditions and 10- and 50 year future conditions under Area Plan Alternatives W, X, Y, and Z for Land Between The Lakes, 2004.

			Indicator Level								
Key Factor	**Current**		**10 Years**					**50 Years**			
(Indicator)			**W**	**X**	**Y**	**Z**		**W**	**X**	**Y**	**Z**
Amount of habitat for Ponds and Marshes Associates (Acres)	952		952	952	952	952		952	952	952	952
(Rating)	**F**		F	F	F	F		F	F	F	F
Amount of habitat for Pine Forest Associates (Acres)	4,366		4,366	4,486	4,486	4,486		4,366	4,686	4,686	4,686
(Rating)	**VG**		VG	VG	VG	VG		VG	VG	VG	VG
Amount of habitat for Grassland Generalist (Acres)	6,522		6,522	7,672	7,672	8,272		6,522	7,262	7,262	7,512
(Rating)	**G**		G	G	G	G		G	G	G	G
Amount of habitat for Canebrake Associates (Acres)	0		0	50	50	50		0	240	240	240
(Rating)	**P**		P	P	P	P		P	G	G	G
Amount of habitat for Den Trees Associates (Acres)	0		713	673	673	684		58,640	51,816	51,816	57,331
(Rating)	**P**		P	P	P	P		G	G	G	G

Table 3.2.8J - (Continued) **Habitat Association** indicator levels and ratings (VG=very good, G=good, F=fair, and P=poor) for current conditions and 10- and 50 year future conditions under Area Plan Alternatives W, X, Y, and Z for Land Between The Lakes, 2004.

			Indicator Level								
Key Factor	**Current**			**10 Years**					**50 Years**		
(Indicator)			**W**	**X**	**Y**	**Z**		**W**	**X**	**Y**	**Z**
Amount of habitat for Regenerating Forest Associates (Acres)	2,535		3,532	5,400	5,400	3,750		3,532	5,450	5,450	3,800
(Rating)	**F**		F	VG	VG	G		F	VG	VG	G
Snag Associates (Acres)	0		713	673	673	684		58,640	51,816	51,816	57,331
(Rating)			P	P	P	P		G	G	G	G
Downed Wood Associates (Acres)	0		713	673	673	684		58,640	51,816	51,816	57,331
(Rating)			P	P	P	P		G	G	G	G
Forest Interior Associates (% forest, including woodlands)	90.2%		89.8%	88.7%	88.7%	89.6%		89.8%	89.0%	89.0%	90.2%
(Rating)	**VG**		G	G	G	G		G	G	G	VG
Forest Interior Associates (% forest, excluding woodlands)	90.2%		89.8%	85.1%	85.1%	87.8%		89.8%	71.4%	71.4%	81.2%
(Rating)	**VG**		G	G	G	G		G	G	G	G

Indicators at “fair” and “poor” levels in the long-term (50 years) are areas for potential concern about persistence of associated species. Under Alternative W, two indicators meet these criteria: Acres of habitat for Xeric and Dry Grassland and Woodland Associates, and Acres of Habitat for Canebrake Associates (Table 3.2.8J). In neither case is progress made to improve abundance of these habitats because such objectives are not recognized in the 1994 Plan. Only the Swainson’s warbler is a known species of viability concern that is associated with the canebrake community. It is at the edge of its range on LBL, so its viability on LBL may be in doubt even if additional canebrake habitat were provided. In contrast, the Xeric and Dry Grassland and Woodland Associates include 18 species of plants and two birds (Table 3.2.8H). Although some of this habitat is provided, its abundance is rated as “poor.” Lack of focus on woodland restoration is this alternative’s biggest weakness when viewed from a community diversity and species viability perspective.

Alternative X and Y show two Habitat Association Indicators below the “good” threshold at 50 years: Acres of Habitat for Mesic Forest Opening Associates, and Acres of Habitat for Riparian Forest Opening Associates. For both, the amount of habitat is expected to increase over time relative to current conditions but does not do so enough to reach the “good” threshold. The primary difference between these alternatives and Alternative W, which rates “poor” for these indicators, is that TVA’s 1994 Plan did not provide for “Forest openings” to be created thru canopy gap type management activities in Mesic and Riparian forest types. Forest opening treatments for creating complex structural diversity thru canopy gaps was provided only on upland xeric and dry site types in TVA’s 1994 Plan (Alternative W). Alternative W includes more effort to open the upland forest conditions to sustain oak, resulting in more habitat for these habitat associations. Under Alternatives X and Y, reduced attention to oak forest management on dry-mesic, mesic, and alluvial sites is a result of a shift in use of vegetation management resources to restore woodlands. So, while some risk is indicated for these habitat groups under this alternative, progress toward increasing habitat availability would be made, these habitat conditions would not be rare, and resources would be applied to more critical restoration activities.

Alternative Z is expected to result in four Habitat Association Indicators below the “good” threshold at 50 years. Like Alternatives X and Y, Alternative Z is rated below the “good” threshold for Acres of Habitat for Mesic Forest Opening Associates and Acres of Habitat for Riparian Forest Opening Associates for many of the same reasons. It also is rated below “good” for Forest Opening Associates and Xeric and Dry Open Forest Associates. The lower rating for these two Habitat Associations reflects this alternatives emphasis on lower levels of management intensity and activity levels. Some level of habitat management would occur in each case, resulting in “fair” ratings. For both of these associations, the amount of habitat is expected to increase over current resulting in improved conditions for associated species. This risk reflects a trade-off between lower intensity management approaches and associated uses versus full biological diversity, which requires restoring some levels of appropriate ecological disturbance to the landscape.

The current Habitat Association Indicator for Ponds and Marshes Associates is below the "good" threshold for all alternatives and does not increase over current in 10 and 50 years. If beaver activity would be allowed to the extent compatible with facility protection and other resource uses, there could be an increase in acreage of quality wetland habitat (i.e., ponds and marshes). Likewise if there are anymore man-made wetlands created in LBL, these acres would be increased.

Management Indicator Species

Threatened and Endangered

The Price's potato bean (*Apios priceana*) a federally threatened perennial vine has been selected as an appropriate MIS for recovery of this species. There are four sites where this species is known to occur in Kentucky and one in Tennessee. The Price's potato bean is an inhabitant of open, mixed-oak forests, forest edges, and clearings on river bottoms, and ravines, and is unable to tolerate deep shade (NatureServe, 2004). This species is also associated with calcareous boulders and several populations extend onto road or utility rights-of-way (NatureServe, 2004). The greatest threat to the LBL populations is shade. There is a need for shade removal on four of the sites (White, 2001). Conservation measures for natural regeneration of the existing populations and propagation of additional populations will follow the Price's Potato bean Recovery Plan (USFWS, 1993). Potential habitat for this species includes forest openings and calcareous cliffs and talus slopes. Forest opening associates habitat potential increases for the Price's potato bean in all of the alternatives in the next 10 and 50 years, based on Table 3.2.8K. There is a considerable increase in potential habitat in the next 50 years.

Table 3.2.8K Potential habitat for population occurrences of Price's potato bean in open forest conditions on LBL under each alternative for 10 and 50 years following Area Plan adoption. Population trend estimates are based on expected trends in habitat quantity and quality.

Time Period	Alternative			
	W	X	Y	Z
10 years	+	+	+	+
50 years	++	++	++	++

[1]Population trend expressed as expected change from current levels: "++" = relatively large increase, "+" = increase, "=" = little to no change, "-" = decrease, "- -" = relatively large decrease.

3.2.9 Demand Species

In addition to requirements for providing for a diversity of plant and animal communities and viability of associated species, units of the national forest system are charged with providing for sustained multiple uses, including recreational use of fish and wildlife populations. The recreational use of fish and wildlife resources in LBL are evaluated for each of the alternatives in terms of their demand by our public. The "demand" label does not imply that a species is of greater value than a "non-demand" species. All species are always "in demand" for one or more reasons (e.g., ecological, scientific, ethical, aesthetic, recreational, commercial, or legal). However, for the purpose of this section, "demand species" are those most associated with the recreational wildlife pursuits (i.e. hunting, fishing, and viewing activities). Because these activities are generally limited or restricted on non-public lands, LBL offers a unique opportunity to those wishing to participate in these activities.

The level of demand for each species or group of species varies to some degree across LBL. Consumptive demand for species includes hunting, fishing, and trapping. A level of demand is also recognized for non-consumptive uses such as viewing, which enhances the experience of forest users.

Some species that exist on LBL are of concern due to their importance for recreation purposes. Some species are in demand for wildlife viewing, some are game species, and some are both. These species population levels are regulated by the constraints of available year-round habitat and/or by harvest regulations. Collectively these species are referred to as Demand Species. They include:

- Bald eagle (*Haliaeetus leucocephalus*)
- Eastern bluebird (*Sialia sialis*)
- White-tailed deer (*Odocoileus virginianus*)
- Eastern wild turkey (*Meleagris gallopavo*)
- Gray squirrel (*Sciurus carolinensis*)
- Northern bobwhite (*Colinus virginianus*)
- Fallow deer (*Dama dama*)

Of these, the bald eagle and northern bobwhite are also listed as species of viability concern.

The bald eagle and Eastern bluebird are demand species for wildlife viewing. The bald eagle is a federally threatened species and the Eastern bluebird is management indicator species for snags in open forested situations and as a non-game demand species. The effects of management are addressed for the bald eagle in the Biological Assessment and for the Eastern bluebird in Section 3.2.7. Following is a discussion of the direct, indirect, and cumulative effects of Alternatives W, X, Y, and Z with respect to their impact on the other five Demand Species population levels. Also outlined are the critical elements and the forecasted impact of harvest on population levels. Alternatives X and Y are considered concurrently because of modest differences in forecasted impacts on critical elements of Demand Species habitat. With the exception of Northern bobwhite and bald eagle, there is no concern to be found in current literature about the viability of the other Demand Species on LBL. Population levels are healthy and are expected to remain so for the duration of the planning period.

In all cases exact populations are difficult or impossible to determine, therefore population trends or coarse, broad-scale determinations are made. In some cases, such as white-tailed deer we have population trend data, in other cases we must tie an individual Demand Species to its habitat and forecast population trends based on the effect an alternative is expected to have on that habitat. An example of this principle is to relate gray squirrel populations to acorn and hickory-nut availability. A vegetation management practice that provides for oak-hickory forest health would be expected to provide for stable or increasing gray squirrel populations.

In most cases vegetation management prescribed to provide for the viability of threatened, endangered, sensitive, or otherwise rare species will have positive effects for Demand Species as well. For example, vegetation thinning and prescribed burning to provide for open oak-hickory woodland habitat (Xeric and Dry Open Forest habitat association) favored by *Prenanthes barbata* or barbed rattlesnake-root a Regional Foresters Sensitive species would have beneficial impacts to white-tailed deer, Eastern wild turkey, and gray squirrel. Conversely, wildlife plantings established traditionally for game species would also contribute to the viability of many non-game species including raptors, small mammals, and migratory songbirds.

Management Indicator Species

The white-tail deer, Eastern wild turkey and Northern bobwhite quail have been selected as appropriate demand game management indicator species. Discussion under each species section will reflect how these MIS will be affected by the proposed management in each alternative.

White-tailed Deer

Affected Environment

White-tails are most frequently found near stream bottoms, draws, swamps, and other riparian areas. They also frequent mixed deciduous and coniferous forests at low to mid elevations with gentle slopes. White-tails are very adaptable to disturbances, such as agriculture and forestry practices, and prefer these areas if adequate forage and cover is available (Snyder, 1991).

Deer nutrition, reproduction, weights, and antler characteristics are influenced by the availability of acorns (Harlow *et. al*., 1975; Feldhammer *et. al.,* 1989; Wentworth *et. al.,* 1990a and1992). Food plots, especially those containing clover-grass mixtures, are used most intensively in early spring. They are also an important source of nutritious forage in winter, especially during mast failure years (Wentworth *et. al.,* 1990b).

White-tailed deer use a variety of habitats ranging from closed canopy forest to croplands. They exist in both remote areas as well as in urban interface. This species is of particular interest to both hunters and wildlife watchers. White-tails are primarily browsers and eat a tremendous variety of plants throughout their range. Forage consumed is regionally specific and usually consists of leaves, twigs, and stems of woody plants, as well as mast, fruits, cultivated crops, and sometimes grasses and forbs. Browse consumption is highest when acorn mast is scarce and lowest when acorn mast is abundant. When white-tails can afford to be selective they tend to choose the most nutritious plants. Some of the most commonly browsed plants are listed below: maple (*Acer spp*.), oak (*Quercus spp.),* hazel

(*Corylus spp*.), dogwood (*Cornus spp.*), sumac (*Rhus spp.*), honeysuckle (*Lonicera spp.*), birch (*Betula spp*.), poplar (*Populus spp*.), willow (*Salix spp*.), cherry (*Prunus spp*.), juniper (*Juniperus spp*.), apple (*Malus spp*.), persimmon (*Diospyros spp*.), hawthorne (*Crataegus spp*.), greenbrier (*Smilax spp*.), buffaloberry (*Shepherdia spp*.), low panicum grasses (*Panicum spp*.), and viburnum (*Viburnum spp*.). White-tails will also eat fleshy berries of cherry, raspberry (*Rubus spp*.), elder (*Sambucus spp*.), and huckleberry (*Vaccinium spp*.) White-tails also eat cultivated crops, most notably corn, alfalfa, and wheat (Snyder, 1991).

Environmental Effects

Prescribed fire is a commonly used tool for white-tail habitat improvement. It can be used to maintain or prevent the development of certain vegetation types and create a diversity of age classes to provide forage and cover. Prescribed fire can also be used to reduce slash, which impedes deer movement, and to reduce duff in areas where quick duff accumulation can prevent growth of understory forage species. Timber harvest is another common and important tool to improve white-tail habitat (Snyder, 1991).

The effects of fire on white-tail habitat have been well documented. Much of the literature reports in detail on the foraging behavior of white-tails following fire. In general, white-tails are seen foraging more frequently on burned sites than adjacent unburned sites. Patchy burns that create a mosaic of browse and cover are usually beneficial to white-tail populations. Historically, logging followed by fire played a major role in the westward expansion of the white-tail's range. In many areas fire suppression has led to a decrease in forage quality and subsequently quantity as early seral communities are replaced with unpalatable browse or browse that grows out of reach of deer. Many studies have reported an increase in plant nutrients following fire, most notably potassium, phosphorus, calcium, and potash. Crude fiber and protein also tend to increase, as well as water and fat content. These nutrient increases tend to be temporary, only lasting a few years before returning to preburn levels. As discussed above white-tailed deer require a variety of habitats. Critical factors are mature mast producing stands, young vigorous stands, cropland, and permanent openings. Populations are controlled in large part by harvest regulations (Snyder, 1991).

All alternatives would provide for the factors critical for sustainable deer populations; however, Alternatives X and Y would likely support the highest population levels because an aggressive thinning program will improve forest conditions and therefore mast production. Repeated prescribed fire will top-kill and stimulate coppice sprouting of many woody forage plants which are currently out of reach for white-tailed deer, including dogwood, sugar maple, smaller oaks and hickories. However, cover, forage, and mast should be in ample supply with all alternatives.

Populations, hunting and viewing opportunities would likely remain stable or increase slightly during the planning period under Alternatives W and Z. Larger increases would be expected under alternatives X and Y due to higher levels of vegetation management and prescribed burning. Refer to Section 3.2.4, Environmental Effects for a more detailed analysis of the major forest cover types.

Eastern Wild Turkey

Affected Environment

Wild turkeys occupy a wide range of habitats, with diversified habitats providing optimum conditions (Snyder, 1992). Mature mast producing stands are critical during the fall and winter, shrubby areas are critical for nesting, and herb dominated areas including native warm season grasses and agricultural areas are critical for brood rearing. Habitat conditions for wild turkey can be enhanced by activities such as prescribed burning and thinning (Hurst, 1978; Pack *et al.,* 1988), and the development of herbaceous openings (Nenno and Lindzey, 1979; Healy and Nenno, 1983). Wild turkeys eat fruits, seeds, tubers, bulbs, and greens of locally common plants. They also eat animals such as snails, spiders, grasshoppers, millipedes, and salamanders (Snyder, 1992). Grasses are usually important spring foods, while mast and fruits are important during the fall and winter. Poults rely on insects for protein. Some plant food species of the wild turkey include flowering dogwood (*Cornus florida*), wild cherry (*Prunus serotina*), black gum (*Nyssa sylvatica*), hackberry (*Celtis occidentalis*), hickory (*Carya spp*.), hawthorn (*Crateagus spp*.), oak, cottonwood (*Populus spp*.), sumac (*Rhus spp*.), wheat (*Triticum aestivum*), alfalfa (*Medicago sativa*), rye (*Secale cereale*), soybean (*Glycine max*), and panic grass (*Panicum spp*.) (Snyder, 1992). Wild turkeys must be near drinking water on a daily basis (Snyder, 1992).

Environmental Effects

As discussed above, wild turkeys require a mixture of forest successional stage habitats to meet their year-round needs. Populations are controlled in part by harvest regulations. Due to the high level of mobility of wild turkey, thinning and prescribed burning would have little impact on population levels. However, disturbance during the nesting season is, and may continue to be, a concern because fire can destroy turkey nests. Fast moving fire may also kill newly hatched turkey poults, but once poults can fly losses are probably negligible.

Timber thinning, regeneration and creation of open, early successional habitat would be greatest under Alternatives X and Y. Alternatives W and Z would have the least impact on wild turkey populations.

Following prescribed fires in the Georgia Peidmont, total seed production of desirable food plants increased from 5.7 pounds per acre to 23.52 pounds per acre. Prescribed fire can be used to stimulate the growth of food plants and promote early spring green-up of grasses. Fire can also reduce litter, exposing seeds and insects, and reduce brush so that turkeys can be wary of predators. Fire can be used to create edges to increase nesting habitat. It can also reduce parasites such as ticks and lice (Snyder, 1992).

Although all alternatives would support viable populations of wild turkey, Alternatives X and Y would support the highest populations due to the creation of early successional habitat characteristics and grasslands through thinning and burning. The effects of each of the alternatives on these key habitat features is discussed in detail in previous sections.

Populations are expected to increase moderately over present levels under Alternatives X and Y and would remain stable or increase slightly under Alternatives W and Z.

Gray Squirrel

Affected Environment

The gray squirrel is a common species on LBL. It is present in almost all areas. Gray squirrels inhabit upland forests with a high availability of mast. They are seldom found far from permanent water sources (NatureServe, 2004). Currently 90 percent of LBL is forested gray squirrel habitat, and there is some limited use of wildlife plantings as well.

Environmental Effects

No alternative would have any significant negative impact to gray squirrel food sources. Alternatives W and Z would maintain populations at current levels whereas Alternatives X and Y may yield a modest increase in mast production that would have a positive impact on the population. Additionally increases in prescribed burning under Alternatives X, Y, and Z would create a steady supply of high quality snags to be used as den trees.

Alternatives W and Z would result in a gradual transition of many acres currently dominated by oak-hickory to succeed to non-mast species such as maple and beech. While gray squirrels do consume the buds of these species they are an unreliable food source due to their susceptibility to frost. The net result would be a gradual decline in optimal gray squirrel habitat.

Alternatives X and Y would result in stabilization of the oak-hickory communities that currently exist on successional sites. Over time, thinning and burning oak-hickory forests results in more open stands, which allows for full crown and mast development in the remaining trees. While this probably will not have an impact on home range sizes, it will increase the average litter size, and over the next decades squirrel population should exhibit a modest increase.

Northern Bobwhite

Affected Environment

The Northern bobwhite has drawn much attention as both a game species and as a species for which there is a viability concern. It is listed as a State Threatened species in Tennessee. North American Breeding Bird Survey (BBS) and Christmas Bird Counts (CBC) indicate a significant range-wide population decline during the last 30 years. Declines are thought to be the result of habitat loss and fragmentation associated with changing land use, particularly clean farming techniques, single crop production, plantation forestry, fire suppression, and replacement of native-grass pasture with tall fescue (*Festuca arundinacea*) (NatureServe, 2004).

Predators of adult Northern bobwhite include hawks and eagles, falcons, foxes, bobcat, and domestic cats and dogs. Predators of chicks and eggs include weasels and skunks, raccoons, Virginia opossum, snakes, crows, rats, squirrels, and chipmunks (Snyder, 1991).

Because the species responds well to management, restoration potential is good. For example, in Arkansas, breeding birds were significantly more abundant in forested stands after the canopy was opened by thinning and prescribed fire than in untreated stands (NatureServe, 2004).

Northern bobwhite nest in shallow ground depression areas where the density of grasses and forbs is moderate (Snyder, 1991). Eggs are laid as early as April in the south, but not until May in the north. This species re-nests as late as September or even October in south Texas. Females can produce up to three broods per season. Above average rainfall and cooler temperatures, particularly in arid regions, increases reproductive success (NatureServe, 2004).

Northern bobwhite are known to eats seeds of at least 650 plant species, including agricultural crops. They tend to eat a larger amount and greater variety of legume seeds than seeds from any other plant family (Snyder, 1991). Important plant foods include legumes, grasses, pine and oak mast, and fruits, but also consume buds, tender leaves, and a wide variety of arthropods. Arthropods are especially important (>80 percent) in the diet of chicks. Although surface water is used when available, it is not necessary for survival or successful reproduction (NatureServe, 2004).

Optimum habitat has been described as consisting of 30 to 40 percent grassland, 40 to 60 percent cropland, 5 to 20 percent brushy cover, and 5 to 40 percent woodland cover. Prescribed fire is also an important management tool, especially in the southeast. Numbers of individuals are higher in areas managed by fire than those not burned. Prescribed fire increases arthropod abundance and facilitates travel of chicks through groundcover vegetation. Fire also reduces hardwood encroachment and promotes the sun-loving groundcover plant species essential for food and cover. Agricultural and silvicultural practices that retain streamside vegetation also benefit this species. Tall fescue dominance can be reduced by disking and herbicide application, or burning and herbicide application followed by establishment of native warm-season grasses (NatureServe, 2004).

Environmental Effects

Northern bobwhite prefer open hardwood forests and southern pine forests, as well as grasslands, pastures, meadows, and agricultural land with shrubby cover. Northern bobwhite tend to avoid areas with dense tree and shrub cover (Snyder, 1991). Good Northern bobwhite habitat requires interspersion of food species and cover that is not too dense.

Rosene, in Snyder (1991), recommended managing forests on an uneven-aged rotation basis, and thinning after 20 years to maintain an open canopy. He also suggested creating park-like woodlands in the South with high open canopies and a thin, spotty pattern of shrubs in the understory.

Fires during the nesting season may destroy nest eggs and young chicks. Prescribed burning has been deemed one of the most effective means of stimulating and controlling vegetation for improvement of Northern bobwhite habitat. Prescribed fires in the pine forests of Alabama increased the number of legume species and improved the quality of their species, which caused an increase in quail numbers (Snyder, 1991).

Fire is a frequently used management tool for Northern bobwhite habitat improvement in the south. Frequent fires that do not allow regeneration of adequate nesting cover may also be detrimental to quail. Pine-oak types in Georgia were burned each year for 3 years to determine the effects of fire on Northern bobwhite nesting success. Sites were burned in late March and early April. Here, late winter or fall burning is recommended over spring and summer burning. Burning between mid-February and the end of March can make seeds available that are buried below the duff layer. Insects begin to emerge after March in the south, and late-spring fires could kill this food source, as well as consume seeds important to Northern bobwhite. Other evidence suggests that spring or summer fires may increase food plants, including some legumes and *Desmodium* species (Snyder, 1991).

Alternative W would maintain existing Northern bobwhite habitat on LBL. Existing openlands and native warm season grass prairies would continue to support a limited population of birds. Although there is no current estimate of the population, existing habitat on LBL is good and should support a population of around 4,500 birds.

Alternatives X and Y would dramatically increase Northern bobwhite habitat by increasing open areas dominated by native warm season grasses and by opening the forest canopy and favoring those forage and cover species preferred by quail. Prescribed burning, forest thinning, and regeneration would create suitable or good habitat on areas where none currently exists. While thinning and timber harvest are very predictable methods of habitat manipulation, prescribed burning produces more variable results. A combination of mechanical manipulation, prescribed fire, wildlife plantings, and row-cropping would produce near optimal habitat for Northern bobwhite. A population estimate based on approximately 2.2 birds per hectare (or roughly 1 bird per acre) multiplied by the amount of quail habitat that would be created over the life of this plan would reach as high as 11,900 birds.

With respect to Northern bobwhite, Alternative Z falls between Alternatives W and X/Y. Limited mechanical treatments and timber harvest would serve to cap the quail population. Prescribed fire alone would be relied upon more heavily in this alternative than in Alternatives W and X/Y. An estimated population is around 7,000 birds.

The combined short and long term impact of Alternative W on quail populations is a little unclear. As oak-hickory forest is replaced by the maple-beech community and associates the amount of available forage for Northern bobwhite would decline. But bobwhite are a versatile forager, and can be expected to make use of any forage available provided that other critical habitat elements are present in a given area. The likely cumulative impact of Alternative W on the Northern bobwhite population on LBL is null. The population could be expected to remain relatively stable.

Alternatives X and Y are expected to hold the greatest benefit for bobwhite. Long term, the population is expected to expand into areas currently considered unsuitable or marginal at best. Spatially large scale thinning, regeneration, woodland-grassland restoration, and continuance of the current practices of wildlife forage plantings and co-op agriculture on LBL are expected to create sustainable, near optimal quail habitat.

Given a long period of time Alternative Z would have a significantly positive impact on Northern bobwhite population as well. Although there would be limited thinning and regeneration and some areas currently suitable for quail would be allowed to succeed to forest, repeated prescribed fire would, over time, thin some areas to open woodland densities. These areas would occur primarily on dry to very dry (xeric) sites. The effect of repeated fire is a gradual thermal thinning on these sites. Given many years and repeated use of prescribed fire these areas would develop into a mosaic of forest, woodland, and xeric grasslands which would be highly suitable quail habitat. Cumulatively the effect would be a gradual juxtaposition of quail habitat from lowland sites to upland in some sites, no net loss of habitat acres, and a modest but significant increase in the number of quail on LBL.

Fallow Deer

Affected Environment

Fallow deer were originally native to Asia Minor, Macedonia, and the shores of the Mediterranean Sea. They were prized for their high quality venison and thrived in captivity. As a result, they are one of the most widely distributed species of deer in the world. Fallow deer were introduced here by the Hillman Land Company around 1918. The Fallow deer herd in LBL is probably the oldest established population in the United States.

The fallow deer herd concentrates in the vicinity of Woodlands Nature Station in LBL's Environmental Education Area (EEA). They are a favorite of visitors to Woodlands Nature Station and wildlife watchers in general.

Fallow deer are smaller than native white-tail deer and somewhat shorter and stockier in appearance. Their colors vary from solid white to almost black. Fallow deer prefer a diet of grass but also eat a wide variety of herbs, shrubs and fruits.

In 1976, 357 fallow deer were captured and tagged on LBL; currently the population is estimated to be around 25-30 animals. Many explanations exist for the dramatic decline including disease and parasites, habitat loss, and lack of new genetic material. In truth all of these factors are probably combining with the fallow deer naturally low reproductive rate to reduce the population. The future of the herd is uncertain.

Environmental Effects

If problems other than habitat loss are responsible for the population decline there is little that can be done to increase the population. The population is centered in the Environmental Education Area and no alternative calls for aggressive vegetation management in the EEA. However, some habitat will be created or enhanced in the EEA under all alternatives, and this would benefit the species. The effect of prescribed fire on fallow deer is unknown but it is reasonable to assume that it would be beneficial since herbs and grasses generally respond positively to fire.

Over the next decades fallow deer habitat will be enhanced in their historic range on LBL. If the population is limited by available habitat, populations should increase. However, if the population's genetic material is deteriorating due to the lack of immigration, it will likely continue to decline. Similarly, if disease and parasites are responsible for the decline, there is little to be done and the population may continue to decrease or stabilize around its current level.

3.2.10 Forest Health

To assess forest health of existing forest stands on LBL on the landscape level, a number of factors including the physical environment, biotic resources, land-use history, need to be taken into consideration. The physical environment of LBL is determined by the proximity of the parallel valleys of the Tennessee and Cumberland Rivers. Closely-spaced tributaries form a dissected topography. These valleys are short with steep gradients in the headwaters, but broad down stream bottomlands. The valleys are now occupied to an elevation of about 358 feet by Kentucky and Barkley Lakes.

LBL is located in the Eastern Broadleaf Forest (Continental) Province at the western edge of Section 222E Interior Low Plateau, Highland Rim, and is within the Western Mesophytic Region, where the vegetation is transitional from the more mesic Mixed Mesophytic Region to the east and the more xeric Oak-Hickory Region to the west. There is no single climax type but a mosaic of types occurs, with local climatic, edaphic, and topographic factors determining specific conditions. Generally, the Western Rim plant life is more closely aligned to the Oak-Hickory Region than to the Mixed Mesophytic Region (Close *et. al.,*. 2002). Chestnut was a lesser component in this physiographic region than in the Southern Appalachians, but was still a significant component in places.

Physical resources include soil, water, and air quality. Poor visibility days in summer due to surface ozone, other aerosols, and particulates are frequent and may be increasing. Ozone is a regional pollutant of concern, causing foliar symptoms in some localities on sensitive species (e.g., yellow poplar, eastern white pine, white ash, black cherry), but oaks are relatively tolerant of ozone. The soils of LBL have developed from limestone bedrock, in Cretaceous gravels or in loess. Many of the soils derived from underlying parent material are typically low in nutrients. Due to the dissected nature of the topography, erosion over a long period of time has had a major impact on the processes of soil formation on the ridgetops and upland slopes. The soils on LBL are directly associated with the site types (xeric, dry, dry-mesic, mesophytic, and riparian) on which the forest vegetative cover types occur.

Oak and hickory likely dominated LBL forests throughout the late Holocene, partially due to the influence of bison herds and partially due to frequent burning by American Indians. The impact on vegetation caused by bison, deer, and elk was mostly eliminated by the mid-1700s due to over exploitation by European settlers. Early Europeans described the local vegetation as either swampy, upland and bottomland hardwood forests, or open savannas, prairies, or barrens (Close *et. al.,* 2002).

Vegetation during the 1900s was highly impacted by the various exploitive activities of the early settlers and their descendants. These activities include iron smelting, agriculture, timber harvesting, whiskey distilling, and the damming of the Tennessee and Cumberland Rivers. Europeans nearly eliminated widespread annual burning, which allowed forests to develop on areas that were historically open savannas, barrens, or prairies. The iron industry brought about resource extraction at all levels resulting in drastic impacts on the upland forested landscape. While extensive areas of land were denuded of forest during the iron industry days, the lack of a forest overstory and high light intensity at ground level were ideal for regeneration of oak and hickory (Close *et. al.,* 2002).

On the dry, high ridges of the Devil's Backbone section of LBL, the Brandon soil series is common with shortleaf pine the dominant forest canopy species on many sites. Shortleaf pine is a successional species and the present understory of mostly oaks, including post, blackjack, white, black, and scarlet, indicate that oak forest ultimately may dominate the overstory (Close *et. al.,* 2002). One early result of systematic inventory of natural resources was an aggressive tree planting program; approximately 1.9 million trees were planted between 1965 and 1974. Most plantings were pine seedlings, but thousands of hardwood seedlings were also planted. Today, planted pine stands in LBL often are found in and around gullies. These are the places where small dams were built and then pine was planted behind them for erosion control.

The historic and present status of oak on the LBL landscape must be considered. Oaks were an important but subordinate component of historic forests. The elimination of American chestnut as a canopy species has elevated oaks to an unprecedented position as the most dominant species group. There is hope for the future recovery of American chestnut through resistance breeding. However, many substantial hurdles remain, not the least of which will be social acceptance of the type, severity, and frequency of disturbance necessary to reintroduce the tree as an ecosystem component functioning in a manner similar to historic forests. The physical and biotic resources of the LBL will support forest cover with or without any proposed management.

Forest ecosystems depend on change for sustainability, stand renewal and growth, and catastrophic changes will continue to occur on LBL over time. Over the past 9,000 years there have been several types of disturbance that enabled sunlight to reach the forest floor. Strong wind events, like the tornadoes that flattened hundreds of acres of the LBL forest in

1968 and 1994, periodically occurred in the past. Wildfires caused by lightening were probably not as common here as in the western United States, but they did occur. Whether started by American Indians or lightening, uncontrolled intense wildfires killed trees. Droughts, such as those in the 1950s, 1970s, and in 1999, would have resulted in widespread death of shallow-rooted trees. Insect outbreaks, such as the late 1980s explosion of leaf defoliators that produced death and loss of vigor to trees across 35,000 LBL acres, also probably occurred in the distant past. And finally, diseases associated with old-age killed many trees. A current example of this is oak decline, where a complex of factors attacks mature trees in the red oak group and kills them. LBL has lost trees from the red oak group (black, scarlet, blackjack, northern red, southern red) at an alarming rate over the past 20 years.

The onset of European occupation included widespread clearing of land for agriculture and the suppression of fire, mainly to protect timber. In the end, agro-deforestation and wildland fire led to the reduction of forest dominance across the landscape. Bottomland forests were converted to agricultural land and were later inundated by the impoundment of Kentucky and Barkley Lakes. The remaining open woodlands succeeded to close forest, currently dominated by oak species (Franklin *et. al.,* 2002).

The prevailing low disturbance regime is not permitting the replacement of dying oaks in many areas. Instead, oaks are being replaced by shade-tolerant mid-story species such as maple and American beech. With over half of upland oak forests vulnerable in LBL, it is also apparent that oak decline represents a significant forest health issue. Whether one considers the reference condition to be the historic chestnut-oak-hickory forest, or the present mixed oak-hickory forest, the combination of chestnut blight, widespread oak decline, and incomplete oak replacement have resulted in new tree species mixtures that are less desirable to many wildlife species. The prevailing low disturbance regime coupled with the relatively homogenous structure of forest stands on LBL places the forest stands across the landscape at risk to catastrophic change.

The pattern of oak decline across landscapes is highly variable and is dependent on complicated and inter-related predisposing factors including previous land-use history, site quality, and stand age. There are cases where outbreaks of defoliators such as the gypsy moth are a significant inciting factor in severe oak decline over large landscapes. Thousands of hectares of severe oak decline mortality occurred during gypsy moth outbreaks, in the mid-1980s, in northern Virginia national forests that may have disturbed water relations, nutrient cycling, and light and growing space for desirable tree reproduction.

Having devastated Northeastern U.S. forests, the gypsy moth (*Lymantria dispar*) now poses a serious threat to forests in the Southeast. Originally from France, the pest is a particular threat to species of red and white oak. In its larval stage, the gypsy moth can defoliate an entire tree, weakening and eventually killing it. Large numbers of gypsy moths can decimate entire stands of trees, especially in drought years when they are already weak.

Biologists studying the gypsy moth know the species is slowly moving south. While it has not yet advanced into western Kentucky and Tennessee, an infestation is likely in the future.

Since 1973, LBL has been part of a USDA Forest Service program to monitor for the presence of gypsy moths. This involves setting out pheromone-baited traps in spring, then collecting them in late summer. Traps are set out in LBL's campgrounds and public use areas, as gypsy moth egg masses are often carried on motor vehicles such as RVs and trailers.

From 1973-1994, only two male gypsy moths were trapped at LBL. When the surveillance program indicates a more substantial presence of these pests, an integrated pest management plan will be launched. Monitoring and detection efforts for gypsy moth and other serious forest pests will continue to be important indicators for maintaining equilibrium between supply and demand of essential resources.

In the United States, sudden oak death is known to occur only along the west coast. However, the fact that widely traded rhododendron ornamentals can be infected with the pathogen and the demonstrated susceptibility of some important eastern oaks make introduction to eastern hardwood forests a significant risk. Early detection will be important for successful eradication. Eastern oak disorders that resemble sudden oak death incude oak wilt, oak decline, and red oak borer.

Oak decline has always been part of the landscape, but it is unlikely that such a large proportion has ever been vulnerable simultaneously. The high proportion of forest area affected by or vulnerable to oak decline illustrates the relative homogeneity of Southern Appalachian oak forests and points to a lack of young, regenerating oak stands and oak stands with more complex age structures. While younger aged stands exist, oaks are not as heavily represented. The current trend in silviculture of upland oak forests is towards stands with more complex age structure, but maintaining an oak component requires direct attention and action. Oak stands on LBL in general are probably unhealthy under this criterion. Current lack of diversity in seral stages and stand structures will continue to pose risks to forest health.

Cohorts of oak that replaced chestnut over large areas in the region are now reaching physiologic maturity and are subject to the stress-mediated disease known as oak decline. Analysis of the four criteria to describe forest health indicates that forest cover on LBL will continue to persist, but with forest-wide risk to oak decline, mostly non-oak species will exploit future available growing space. The future result will be a new forest with a smaller and less diverse oak component. Chief among the forces guiding the development of this new forest, fire suppression and social resistance to intentional forest disturbances, unfavorable growing conditions for oak stand replacement will persist across the forest landscape on LBL. Oaks will continue to be represented in the new forest but expected to lose their current level of dominance across the forest landscape and the new forest will be less susceptible to oak decline; however, some social values met by oak forests (e.g. some wildlife habitat components and economic value of timber) will be compromised.

3.2.11 Non-Native Invasive Species

The Chief of the Forest Service has identified invasive species as one of the four threats to our Nation's ecosystems. Through internal and external collaboration, the Forest Service is currently in the process of developing a National Strategy to guide efforts to more aggressively address the invasive species threat. The national strategy will be directly tiered to the Forest Service Strategic Plan and the National Invasive Species Management Plan prepared by the National Invasive Species Council.

A definition of invasive species from Executive Order 13112 is provided. Essentially, a species is considered invasive if:

- It is not native (i.e. alien) to the ecosystem under consideration; and
- Its introduction causes or is likely to cause economic or environmental harm or harm to human health.

Invasive species threaten the sustainability of our forest ecosystems, regionally, nationally, and globally. Forests within the thirteen states of the Southern Region are rich in biological diversity and provide vital goods and services. The current infestations and growing threat of non-native invasive species can displace diversity and habitats, disrupt vital ecosystem functions, and degrade productivity and recreational benefits. Non-native invasive plants, insects, diseases, mammals, fish, mussels, snails and earthworms have increased in their range and severity, while others await entry through global commerce. A well conceived and organized program of invasive species prevention and management is warranted and overdue. This Non-Native Invasive Species Strategy (NNIS) for the Southern Region is part of an ongoing national effort to combat existing non-native invasive species populations and curtail entry of new non-native invasive species.

Generally, biological invasion is promoted by disturbance. Building and/or maintaining roads into a forest represent disturbances that create and maintain new edge habitat. These roadside habitats can be invaded by a suite of exotic invasive plant species, which may disperse by natural agents such as wind, water, and wildlife. It appears that the level of road is not a determining factor in invasive plants, as plants colonize on even Level 1 roads. (Southern Forest Resource Assessment - Effects of Linear Land Use on Forest Wildlife, October 2002).

There are a number of laws, regulations and policies that relate to NNIS management on National Forest system lands, only a few of which are listed here. The principles of Forest Service Manual (FSM) 2080 address Noxious Weed Management on National Forest Systems and can be interpreted broadly to accomplish the objectives of Executive Order 13112 for all NNIS plant and animal species.

Table 3.2.11A lists invasive non-native species that are relatively widespread and locally abundant primarily in wildlife openings, along the 68/80 highway corridor, and across other areas of Land Between the Lakes. The species list was derived from the "Modified and Extended Report on Botanical Survey of Wildlife Opening Margins” by Julian Campbell, January 3, 2003, “Invasive Weed Threat” list from Scott Gunn’s report of 68/80 highway, and some species discussed in the 1994 TVA NRMP.

There were a number of invasive non-native weed species that rated severe from Scott Gunn’s Invasive Weed Species report. This list includes Tree of Heaven (*Ailanthus altissima*), Japanese siltgrass (*Eulalia viminea*), Sericea lespedeza (*Lespedeza cuneata*), European privet (*Ligustrum vulgare*), Loblolly pine (*Pinus taeda*), Multiflora rose (*Rosa multiflora*), Kudzu (*Pueraria montana*), Large periwinkle (*Vinca major*), and Common periwinkle (*Vinca minor*).

The Goal of the R8 NNIS Program in the South is to reduce, minimize, or eliminate the potential for introduction, establishment, spread, and impact of non-native invasive species across all landscapes and ownerships. Table 3.2.11B identifies the list of species that the Region 8 Regional Forester has identified as non-native and invasive. Category 1 species are exotic plant species that are known to be invasive and persistent throughout all or most of their range within the Southern Region. Category 2 species are exotic plant species that are suspected to be invasive or are known to be invasive in limited areas of the Southern Region.

Table 3.2.11A - Invasive non-native species known to occur on Land Between The Lakes.	
Common Name	**Scientific Name**
Abelia	*Abelia grandiflora*
Common yarrow	*Achillea millefolium*
Tree of Heaven	*Ailanthus altissima*
Mimosa	*Albizia julibrissim*
Wild garlic	*Allium vineale*
Pigweed	*Amaranthus retroflexus*
Small carpgrass	*Arthraxon hispidus*
Japanese barberry	*Berberis thunbergii*
Flowering quince	*Chaenomelis jabonica*
Crown vetch	*Coronilla varia*
Queen Ann's lace	*Daucus carota*
Smooth crabgrass	*Digitaria ischaemum*
Hairy crabgrass	*Digitaria sanguinalis*
Autumn olive	*Elaeagnus umbellata*
Japanese siltgrass	*Eulalia viminea*
Climbing euonymus	*Euonymus fortunei*
Tall fescue	*Festuca elatior*
Yellowbells	*Forsythia suspensa*
Yellowbells	*Forsythia viridissima*
Ground ivy	*Glechoma hederacea*
Orange daylily	*Hemerocallis fulva*
Shrubby lespedeza	*Lespedeza bicolor*
Sericea lespedeza	*Lespedeza cuneata*
Common lespedeza	*Lespedeza striata*
Chinese privet	*Ligustrum sinense*
European privet	*Ligustrum vulgare*
Bush honeysuckle	*Lonicera bella*
Japanese honeysuckle	*Lonicera japonica*
Nepal grass	*Microstegium vimineum*
Princess tree	*Paulownia tomentosa*
Beefsteak plant	*Perilla frutescens*
White pine	*Pinus strobis*
Loblolly pine	*Pinus taeda*
Kentucky bluegrass	*Poa pratensis*
Smartweed	*Polygonum sp*
White poplar	*Populus alba*
Multiflora rose	*Rosa multiflora*
Giant foxtail	*Setaria faberi*
Green bristlegrass	*Setaria viridis*
Johnson grass	*Sorghum halpense*
Bridal wreath	*Spiraea spp*
White clover	*Trifolium repens*
Large periwinkle	*Vinca major*
Common periwinkle	*Vinca minor*
Chinese wisteria	*Wisteria sinensis*
Cocklebur	*Xanthium commune*

Table 3.2.11B - Regional Forester's List of Category 1 and 2 Weed Species, May 2001.			
Category 1 Species		**Category 2 Species**	
Scientific Name	**Common Name**	**Scientific Name**	**Common Name**
Ailanthus altissima	Tree of heaven	*Allium vineale*	Wild garlic
Alliaria petiolata	Garlic mustard	*Alternanthera philoxeroides*	Alligator weed
Ardisia crenata	Scrated throat	*Ampelopsis brevipedunculata*	Amur peppervine
Berberis thunbergii	Japanese barberry	*Arthraxon hispidus*	Small carpgrass
Celastrus orbiculatus	Oriental bittersweet	*Bromus inermis*	Smooth brome
Cinnamomum camphora	Campho rtree	*Carduus nutans*	Nodding plumless thistle
Dioscorea alata	Water yam	*Centaurea maculosa*	Spotted knapweed
Dioscorea batatas	Air potato	*Cirsium arvense*	Canadian thistle
Dioscorea bulbifera	Chinese yam	*Egeria densa*	Brazilian waterweed
Eichhornia crassipes	Common water hyacinth	*Elaeagnus angustifolia*	Russian olive
Elaeagnus umbellate	Autumn olive	*Elaeagnus pungens*	Thorny olive
Euonymus fortunei	Winter creeper	*Eragrostis curvula*	Weeping lovegrass
Hydrilla verticillata	Waterthyme	*Hedera helix*	English ivy
Imperata cylindrical (including I. brasiliensis)	Cogongrass	*Kummerowia striata (=Lespedeza striata)*	Japanese clover
Ligustrum japonicum	Japanese privet	*Macfadyena unguis-cati*	Catclaw vine
Ligustrum lucidum	Glossy privet	*Melia azedarach*	Chinaberry tree
Ligustrum sinense	Chinese privet	*Mimosa pigra*	Black mimosa
Ligustrum vulgare	European privet	*Myriophyllum spicatum*	Spike watermilfoil
*Lolium arundinaceum *(=Festuca elatior vararundinacea)*	Tall fescue	*Nandina domestica*	Sacred bamboo
Lonicera fragrantissima	Sweet breath of spring	*Pistia stratiotes*	Water lettuce
Lonicera japonica	Japanese honeysuckle	*Polygonum caespitosum*	Asiatic smartweed
Lonicera maackii	Amur honeysuckle	*Polygonum perfoliatum*	Asiatic tearthumb
Lonicera morrowii	Morrow's honeysuckle	*Spiraea japonica*	Japansese meadowsweet
Lygodium japonicum	Japanese climbing fern	*Vetiveria zizanioides* **	Vetiver grass
Lygodium microphyllum	Small leaf climbing fern	*Wisteria floribunda*	Japanese wisteria
Lythrum salicaria	Purple loosestrife	*Wisteria sinensis*	Chinese wisteria
Microstegium vimineum	Japanese stiltgrass		
Paederia foetida	Stinkvine		
Panicum repens	Torpedo grass		
Polygonum cuspidatum	Japanese knotweed		
Pueraria montana	Kudzu		
Rhodomyrtus tomentosus	Rose myrtle		
Salvinia molesta	Kariba-weed		
Sapium sebiferum	Tallow tree		
Schefflera actinophylla	Octopus tree		
Schinus terebinthifolius	Christmasberry		
Solanum viarum	Tropical soda apple		
Sorghum halepense	Johnson grass		
Verbena brasiliensis	Brazilian vervain		

*=Applies only to endophyte-enhanced cultivars. All KY31 Tall Fescue is considered endophyte-enhanced.
**=Prohibition dies not apply to sterile (nonflowering) cultivars of zizanioides

Around LBL facilities and rights of ways, integrated pest management practices include mowing, soil disturbance, mulching, plantings of grasses and shrubs, controlled burning, and the use of EPA-registered herbicides. Herbicides are used by cooperative farmers, contractors, and LBL operators who are state-certified pesticide applicators or under the direct supervision of a state-certified applicator. Exceptions would be for herbicide use on rights of way managed by their respective utilities or highway departments and not directly controlled by LBL; e.g., TVA Power, Pennyrile Electric, Cumberland Electric, American Natural Gas Companies, and Kentucky Department of Transportation.

Over the last two years, LBL has established approximately 626 acres of native warm season grasses in Kentucky and Tennessee. In fiscal year 2004 alone, LBL has established these grasses in places such as the Elk and Bison Prairie, Woodlands Nature Station, Pryor Hollow, Long Creek, Crocket Creek/Crocket Hollow, and Tharpe Fields totaling 320 acres of native grass species. During this Area Plan revision process, we will incorporate and adopt Forest Service Manual direction to address the threat of non-native invasive species to allow for various types of management actions such as chemical, mechanical, and prescribed fire for native species restoration and protection.

The use of native plants for revegetation and restoration is integral to the overall national goal of conserving the biodiversity, health, productivity, and sustainable use of forest, rangeland and aquatic ecosystems. Maintaining biodiversity includes retaining the genetic variability within plant populations. The policy provides guidance for planning and implementing revegetation projects including rehabilitation and restoration of forest, range, and aquatic ecosystems (FMS 2200, Ch. 2240.1).

A discussion on gypsy moth and oak decline can be found under the 3.2.10 Forest Health Section.

3.3 Resource Management

Resource Management covers many allocations and aspects of LBL that are not general forest or recreation areas. This section describes the Core Areas in the General Forest, approximately 25 percent of LBL, that are managed to demonstrate natural resource management and protection. This section also addresses the area of Fire Management, which includes naturally occurring and prescribed fires on LBL, and its uses, preventions, and applicability as a silvicultural method. The Roads and Infrastructure Management portions are included in this section as well and outlines the impact the alternatives could have under each.

3.3.1 Core Areas

The emphasis of management in the Core Areas is to build harmonious relationships between humans and the environment. (Action Plan for Biosphere Reserves, 1984) Core Areas are used to develop greater understanding in wise use of the area's renewable resources, in conserving and promoting the conservation of its unique and fragile attributes, in supporting sustainable development, and by serving as a demonstration of both natural resource management and protection. This is accomplished in cooperation with other agencies and organizations.

Affected Environment

The Core Areas consist of a network of small, medium, and large tracts of land that provide research opportunities for investigating site-dependent and configuration concerns for resource management. The purpose for this range of core sizes is to facilitate greater understanding of factors determining optimum size of natural reserves for various flora and fauna community types. Approximately 35,200 acres make up the Core Areas at LBL. The location of these acres is illustrated on the Alternative W prescription map in Appendix I.

Management of Core Areas

Core Areas are minimally disturbed ecosystems which are protected to serve as benchmarks or experimental controls for comparative studies with actively managed acres. Environmental education and recreation activities which have minimal environmental impacts are encouraged in Core Areas. Estimates of old growth are discussed in Section 3.2 of this FEIS. With few exceptions, natural processes have determined eventual vegetation conditions; however, in some cases, the prevailing environmental conditions have changed to prevent, or at least hinder, natural processes. Examples of these conditions include past land-use activities and an influx of non-native species.

Vegetative management techniques may be used for ecological restoration or to maintain or enhance habitat conditions for federally listed threatened or endangered species. Such management techniques also may be necessary to perpetuate unique plant communities or to control non-native species.

The Core Areas contain ecological, geological, or other features of scientific, educational, scenic, or historic value. These areas have been protected and managed to perpetuate their rare or unique attributes. The Core Area blocks provide a baseline control for long-term ecological research and serve as ecological restoration areas. Seven Core Area blocks (Large and Medium Blocks) range in size from approximately 2500 acres to 11,000 acres, totaling over 35,000 acres. The remaining Core Areas fall in smaller blocks throughout LBL. The prescription maps in Appendix I illustrate the Core Areas sizes and locations across LBL.

Large and Medium Blocks

The Large and Medium Blocks provide a baseline control for long-term ecological research under the Man and the Biosphere Program and serve as ecological restoration areas. These Large and Medium Blocks include three large blocks and four medium size blocks. Large Blocks comprise approximately 24,320 acres, and Medium Blocks comprise approximately 11,640 acres (1994 Plan). Most of these large and medium tracts encompass entire watersheds.

Ecology Study Areas

Ecology study areas have been identified as having unique vegetation, historical, or geologic features. These ecology study areas are listed in the appendix to the 1994 Plan. Most of these areas have been protected since the early 1970s with minimal active management. Many of these areas are incorporated in the Large and Medium Blocks. Management emphasis will be placed on each area's unique attributes. Ecological Study Areas are smaller in size than the Large and Medium Blocks; however, visitors experience many of the same features of the larger areas. These areas have been be protected and managed to perpetuate their rare or unique attributes.

Research Natural Areas

Research Natural Areas under the 1994 Plan are a part of the Society of National Foresters network of special areas set aside to allow for studying natural ecological processes. Three were identified in LBL as having unique vegetative features with the emphasis aimed at providing suitable to optimal habitats to support populations of the plant and animal species associated with these communities. Two of these areas are incorporated into the Core Areas in the 1994 Plan.

The two State Natural Areas on LBL are both in the Tennessee portion, and are incorporated into the most southern Core Areas. These areas are managed under a mutual agreement between the Tennessee Department of Conservation and the US Forest Service. State Natural Area agreements are designed to aid both parties in their efforts to recognize and conserve the scenic, natural, and aesthetic values of the areas. The State Natural Areas at LBL have been identified as having unique vegetative features with the emphasis aimed at providing suitable to optimal habitats to support populations of the plant and animal species associated with these communities.

The Slopes of Bear Creek State Natural Area, located on the eastern side of the Trace, supports a variety of oaks and other hardwoods as well as a number of plant species of special concern.

The Devil's Backbone State Natural Area, located on the western side of the Trace, contains a native shortleaf pine community. Management emphasis has been placed on restoring the shortleaf pine forest in this SNA by exposing more mineral soil and high light levels. Thinning and burning perpetuates the unique attributes of this shortleaf pine community.

Effects of All Alternatives

The amount of acres allocated to Core Areas in each alternative are listed in Table 3.3.1A and illustrated on the prescription maps in Appendix I.

There are good to optimal habitat conditions in the Core Areas for mid- to late-successional deciduous forest associates; area-sensitive, mid- to late-successional deciduous associates; bottomland hardwood associates; mixed mesic forest associates; basic mesic forest associates; mixed xeric forest associates; and basic xeric forest associates. In some cases, plant and animal species which formerly occurred in late successional forest types in the LBL region could be reintroduced.

The naturally-evolving character of the landscape due to low intensity management within forested areas will result in primarily older forests with areas of continuous canopy and occasional gaps as a result of storms, insect or disease outbreak, fire, reverting fields, and fields with managed native early successional stage vegetation. Old-growth forest communities is expected to increase over the decades, except where significant natural disturbances occur. Future old growth in the Core Areas is discussed in the old growth section of this EIS. With few exceptions, natural processes would determine eventual vegetation conditions; however, in some cases, the prevailing environmental conditions have changed to prevent, or at least hinder, natural processes. Examples of these conditions include past land-use activities and an influx of nonnative species.

Recreation opportunities in Core Areas include scenic driving, bird-watching, wildlife viewing, nature photography, horseback riding, hunting, fishing and hiking. Access to Core Areas consist sof public roads, administrative roads, hiking trails, horse trails, and bike trails. Visitors may encounter cemeteries, and old homesteads. Maintenance or new activities in the Core Areas, particularly in the larger blocks, will complement, not detract from a semi-primitive recreation experience. Visitors enjoy a natural setting isolated from sights and sounds of other human activity.

Table 3.3.1A: General Forest Core Areas by Alternative

	W	X	Y	Z
Core Areas (Acreage)	35,000	40,800	41,800	45,600
Core Areas (Percent of LBL)	20	24	24	27

Effects of Core Acres Under Alternative W

Under this alternative the Deferred Area designation described in TVA's 1994 Plan would no longer exist. Approximately 10,400 acres would be incorporated into the General Forest and some would be incorporated into developed area prescriptions. The Core Areas total acreage would be approximately 35,000 acres (less than the 1994 Plan's target of 42,500).

The difference in acres between the goal and the current condition is not expected to have a large impact on the resources at LBL. Approximately six percent of LBL that had deferred management under the 1994 plan becomes part of the forest available for more active management. This more active vegetation management would support species needs. This six percent of LBL would continue to provide dispersed Rec/EE experiences.

Effects of Core Acres Under Alternative X

Under Alternative X, approximately 5,600 acres, or four percent of LBL, described as Deferred Area designation in TVA's 1994 Plan would become Core Areas. These acres were selected primarily from deferred acres located outside of developed facility boundaries to support the emphasis on developed facilities. The total Core Area lands under Alternative X would be approximately 40,800 acres, within four percent of the 42,500 acres goal set in the 1994 plan. The remaining 4800 acres of deferred areas would be incorporated into General Forest Areas or Developed Recreation Areas.

This change in acres is not expected to have a large impact on the resources at LBL. Approximately 5,600 additional acres would be added to the Core Areas. A total of approximately 40,800 acres would be areas of low intensity management to support the objectives of greater understanding of ecosystems and to provide more remote recreational experiences and non-facility-based environmental education. The amount of estimated old growth in these Core Areas is discussed in the Old-Growth section of this chapter.

Effects of Core Acres Under Alternative Y

Under Alternative Y, approximately 6600 acres described as Deferred Area designation in TVA's 1994 Plan would become Core Areas. These acres were selected primarily from deferred acres located within developed facility boundaries to support the emphasis on dispersed recreation opportunities. However, no Core acres were selected within the boundaries of Hillman Ferry or Rushing Creek Campgrounds, Turkey Bay OHV Area or The Homeplace-A Living History Farm. The total Core Area acreage under Alternative Y would be approximately 41,800 acres, within two percent of the 42,500 acre goal set in the 1994 Plan. The remaining 3800 acres of deferred areas would be incorporated into General Forest Areas.

This change in acres is not expected to have a large impact on the resources at LBL. A total of approximately 40,800 acres would be areas of low intensity management to support the objectives of greater understanding of ecosystems and to provide more remote recreational experiences and non-facility-based environmental education. The amount of future old growth in these Core Areas is discussed in the Old-Growth section of this chapter. The additional Core Areas in Alternative Y are spread across the landscape of LBL.

Effects of Core Acres Under Alternative Z

Under Alternative Z, all areas identified as deferred areas, approximately 10,400 acres, in TVA's 1994 Plan would become General Forest Core acres. The total Core Area acreage under Alternative Z would be approximately 45,600 acres, approximately seven percent greater than the 42,500 acres goal set in the 1994 Plan.

This change in acres is not expected to have a large impact on the resources at LBL. Approximately 27 percent of LBL is in Core Areas in Alternative Z. An additional 10,000 acres would be minimally managed and provide Rec/EE opportunities in small areas across LBL. Alternative Z provides for the highest acreage of land designated as having minimal vegetation management of all the alternatives.

3.3.2 Fire Management: Prescribed and Wildland Fire

Affected Environment

Wildland fire in the south results from two forces. One is natural, those caused by lightning, and the anthropogenic, those caused by humans. Historically, fire has been used for thousands of years by American Indians over the landscape to aid in hunting, clear land for travel, increase berry crops, improve grazing for bison and other reasons.

It was this prescribed fire that has shaped the forest over the years. These fires were ignited with a designed purpose to achieve a specific vegetative response - a response that was a benefit to the indigenous American Indian tribe. However, European settlers have populated the eastern United States since the early 1700s and modern fire suppression efforts have all but removed anthropogenic fire from the landscape.

Science continues to teach us about fire's role in the historic landscape of Kentucky and Tennessee and how it modified the vegetation. Biologists have documented corresponding changes in vegetation, including the decline of many fire-adapted communities since the removal of fire from the landscape. Fire-adapted communities are dependant on a historic disturbance regime. This is evident from the increase of dense understory vegetation that no longer resembles the overstory, as a result of fire exclusion. Without fire or other disturbances, the forest composition is slowly converting to species such as maple, beech, blackgum, and white pine.

There is an ongoing debate over the use of fire to restore vegetative communities to the Pre-European settlement or "Natural" assemblage. Some publics argue that human-ignited fires are not natural; therefore, should not be used in the management of national forests. This argument implies that the use of fire by American Indians was not part of the natural system. However, converting the forest to vegetation that was here during the American Indian dominance is no longer a viable option. The climate and vegetative species dominance has changed as well as the influence and abundance of the modern population.

Patterson and Sassaman (1988) compared amounts of sedimentary charcoal to archaeological sites and found that fires were common near larger American Indian populations and where their land-use practices were greatest. Charcoal records prior to European settlement and post-settlement show little difference except during the slash fires associated with the logging boom at the turn of the century. These records clearly suggest that fires have been important in that area for the past 4,000 years, during a period of low lightning incidence. Human use of fire has been important in determining plant community composition (see also Sutherland, and others, 1993).

In the past, fire was likely the most common natural disturbance on the landscape that is now LBL. Fire plays an important role in maintaining southern yellow pine ecosystems and appears to be a major factor in the development of oak forest. The current existence of oak-dominated forests is probably a result of periodic fire. Without periodic fire, many of these stands would eventually be replaced by more shade tolerant species such as red maple that are fire-intolerant.

In the early 1900s the national direction of the Forest Service was quite clear (Pyne, 1982)..."Forest fires have no place in any forest but as a result of ignorance, carelessness, and indifference (Anonymous, 1936)." The practitioners of controlled burning battled against an enormous campaign set at the national level to stop all fire. With that new direction of suppressing all fires, that major force of selection that had been present since the ice age was suddenly altered. The consequences of that well-intentioned but misguided policy would not be obvious for several decades. The selection process that influenced plant and animal communities now changed with the absence of fire.

Perhaps, though, in defense of the dedicated firefighters during these times, this is the way it had to happen. Fire fighting equipment, intelligence, weather forecasts, budgets and fire behavior prediction have only recently enabled prescribed fire on a substantial level. Recent scientific literature regarding plant and animal reactions and effects are now better known. We have better data on pre-eurosettlement conditions. And now we are beginning to understand some of the more dramatic long-term impacts of fire exclusion as plant and animal populations and conditions of forest ecosystems are altered.

Research suggests many reasons for the use of prescribed fire as a vegetation management tool. Foresters, wildlife managers, recreation managers, and fire managers all have valid uses for fire. The following is list for possible uses of fire on LBL:

- Hazardous fuel reduction to minimize catastrophic fire;
- Enhancement of wildlife browse and soft mast;
- Regenerate fire dependant species, such as yellow pine, endangered and sensitive species;
- Increase the regeneration of oaks, reducing competition from maple, beech, blackgum, white pine, and poplar;
- Reduce non-native species;
- Improve over-all forest health by reducing diseases and insects;
- Maintain successional stages, and unique habitats, such as balds, by inhibiting succession;
- Maintain open stands for scenery enhancement and recreation use.

Encompassing many of these uses is the utilization of fire to achieve ecosystem-based management goals for ecological communities where fire has played a major role in natural stand replacement or maintenance. They are all very consistent with LBL's mission.

This is not a complete list and many of the uses overlap. Occasionally, burning for one purpose precludes another benefit, but usually burning for one reason creates many other benefits. For instance, a hazardous fuel reduction burn will usually enhance browse, open up the stands for recreation use, and reduce competition of fire intolerant species, which improves the growing conditions for mast-producing oaks.

Prescribed fire is an economical tool to manage large areas where other forms of management are not likely to be used. The amount of LBL that could reasonably be managed by mechanical and manual methods is limited by personnel and funding restrictions. There is extensive acreage on LBL where fire is the only form of management activity that could ever be reasonably accomplished.

Prescribed fire, despite concerns about its use, remains an important, ecologically appropriate management tool. Both natural fuels and artificially produced management-activity fuels must be managed over time to meet long-term resource management objectives. Artificially produced fuels have been of little concern because of the small volume generated, but may have to be managed in the future. The EPA states (EPA, 1998) that while future air quality concerns from prescribed fire may arise, fire should function in its natural role in maintaining healthy wildland ecosystems. It also protects human health and welfare by mitigating the impacts of air pollutant emissions on air quality and visibility.

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 (Frost, 1998). Coarsescale definitions for natural (historical) fire regimes have been developed by Hardy *et. al.,* (2001) and Schmidt et al. (2002), and interpreted for fire and fuels management by Hann and Bunnell (2001). The five natural (historical) fire regimes are classified based on average number of years between fires (fire frequency) combined with the severity (amount of replacement) of the fire on the dominant overstory vegetation. These five regimes include:

- I – 0-35 year frequency and low (surface fires most common) to mixed severity (less than 75 percent of the dominant overstory vegetation replaced);
- II – 0-35 year frequency and high (stand replacement) severity (greater than 75 percent of the dominant overstory vegetation replaced);
- III – 35-100+ year frequency and mixed severity (less than 75 percent of the dominant overstory vegetation replaced);
- IV – 35-100+ year frequency and high (stand replacement) severity (greater than 75 percent of the dominant overstory vegetation replaced);
- V – 200+ year frequency and high (stand replacement) severity.

As scale of application becomes finer these five classes may be defined with more detail, or any one class may be split into finer classes, but the hierarchy to the coarse scale definitions should be retained.

Table 3.3.2A represents the approximate current acreage of fire dependent and adapted communities on LBL with fire regime designation.

Table 3.3.2A Fire Adapted Communities with Fire Regime Designation

Community Type	Acres	Fire Regime
Dry-Mesic Oak Forest	88,900	I
Xeric-Dry Oak Forest	51,800	I
Grassland	6,500	I
Native Shortleaf and Planted Pine	4,300	I

Prescribed fire and mechanical fuels treatments are designed to reduce the risk of catastrophic wildfires by decreasing the amount of available fuel that the fire is able to consume and thus carry the fire. Both methods are utilized to restore fire regimes within or near an historical range. Condition classes are a function of the departure from historical fire regimes resulting in alterations of key ecosystem components such as species composition, stand structure, successional stage, stand age, and canopy closure. One or more of the following activities may have caused this departure: fire exclusion, timber harvesting, grazing, introduction and establishment of exotic plant species, insects and disease (introduced or native), or other past management activities. Fire condition class is a measure of general wildland fire risk and ecosystem condition defined as follows:

- Condition Class 1:
    - Fire regimes are within or near an historical range;
    - The risk of losing key ecosystem components is low;

    - Fire frequencies have departed from historical frequencies by no more than one return interval;
    - Vegetation attributes (species composition and structure) are intact and functioning within an historical range.
- Condition Class 2:
    - Fire regimes have been moderately altered from their historical range;
    - The risk of losing key ecosystem components has increased to moderate;
    - Fire frequencies have departed (either increased or decreased) from historical frequencies by more than one return interval. This results in moderate changes to one or more of the following: fire size, frequency, intensity, severity, or landscape patterns;
    - Vegetation attributes have been moderately altered from their historical range.
- Condition Class 3:
    - Fire regimes have been significantly altered from their historical range;
    - The risk of losing key ecosystem components is high;
    - Fire frequencies have departed from historical frequencies by multiple return intervals. This results in dramatic changes to one or more of the following: fire size, frequency, intensity, severity, or landscape patterns;
    - Vegetation attributes have been significantly altered from their historical range.

LBL uses prescribed fire to reduce fuel loading and to breakup fuel continuity, both vertically and horizontally, to reduce rates of spread and therefore fire size, intensity, and severity. Nationally, the direction is to increase hazardous fuels treatment in the wildland urban interface areas. Those areas are the most expensive areas to suppress wildland fires and pose the greatest threat to public and firefighter safety. Though there is not a one-to-one correlation between acres treated and suppression dollars saved or fewer acres burned, there is sufficient evidence to show that areas that have been treated typically exhibit lower rates of spread, less intensity, less severity, and a smaller final fire size under normal conditions.

Direct, Indirect and Cumulative Effects

Fire has been shown to be a significant and necessary component in developing and maintaining forest and ecosystem health. Its intentional use and applications, as well as its use in wild fire situations, provides the Forest Service with a natural means of regeneration and fuels reduction that is applicable to all managed areas. The following apply to all Alternatives, with exceptions noted in subsequent paragraphs.

Regardless of the Proposed Action chosen, fire use will be considered in both the dormant season and the growing season. This is the current direction of management and should be considered in all alternatives.

The following effects statements are extracted from R8-TR-11, *A Guide for Prescribed Fire in Southern Forests* (Wade and Lundford, 1989), a publication of the U.S.D.A. Forest Service unless otherwise noted.

Prescribed burning has direct and indirect effects on the environment. Proper use of prescribed fire, and evaluation of the benefits and costs of a burn require knowledge of how fire affects vegetation, wildlife, soil, water, and air. Burning techniques and timing of burns can be varied to alter fire effects.

Effects on Vegetation

Plants in fire-prone ecosystems have adapted to fire in various ways, including thickening of bark, ability to resprout from below the soil surface, and dispersing seeds (Stanturf *et al.*, 2002). Shortleaf pine is a classic example of these adaptations. Above ground portions of hardwood species (which overwhelmingly predominate on LBL) are not as resistant to fire damage as conifers, primarily because of thinner bark.

Hardwoods typically resprout from the base of the stem or form root suckers, when the tops are killed by fire. Larger hardwood stems (oak, hickory, poplar) are much less susceptible to top-kill. In one study (Waldrop *et al,* 1992) many hardwood stems over 6 inches in diameter at breast height survived after 30 years of low intensity, annual burning with little stem damage. It is a general principle, however, that increasing diameter decreases sprouting potential after top-kill.

Prescribed fire does kill some large trees, and in woodland restoration areas this is intentional. Growing season fires will kill a larger portion of trees when compared to a fire of similar intensity during the dormant season (Smith and Sutherland, 1999). Large trees die slowly when killed by fire. This is due to initial scarring by fire which leads to invasion of the tree by insects and fungus that if not fatal to the tree will weaken it to the point that it will likely die as the result of additional fires.

Frequent burning (3 to 4 times over 10 years) limited development of a sapling layer and canopy recruitment, however seedling density was not affected (Peterson and Reich, 2001). Fire will have a significant impact on forest canopy structure by causing the immediate mortality of individual tree stems and indirectly by restructuring both canopy structure/composition and age class distribution. Another meaningful and desirable result of prescribed fire will be a significant change in the herb layer in areas burned repeatedly. The frequency and richness of native plants increased by an average of 20 percent and 11 percent respectively on two sites treated with prescribed fire. There were some decreases in frequency as species adjusted to the disturbance (Huthinson and Sutherland, 2000). Perennial herbs and vines decrease in importance values and native grasses and forbs take their place.

Effects on Wildlife

The major effects on wildlife are indirect and pertain to changes in food and cover. Prescribed fires can increase the edge effect and amount of browse material, thereby improving conditions for deer and other wildlife. Quail and turkey favor food species and semi-open or open conditions that can be created and maintained by burning. Burning can improve habitat for marshland birds and animals by increasing food production and availability (Davis *et al,* 2000).

The deleterious effects of prescribed fire on wildlife can include destruction of nesting sites and possible killing of birds, reptiles, or mammals trapped in the fire. Fortunately, prescribed fires can be planned for times when nests are not being used. Also, virtually all the types of prescribed fire used in the South provide ample escape routes for wildlife. For example, in one study a large tract was operationally burned with aerially-ignited spot fires and immediately examined for wildlife mortality. Fish and game agency personnel found none, but noted deer moving back into the still-smoking burn.

Prescribed fire does not benefit fish habitat, but it can have adverse effects. This is somewhat of a moot point however, because it is often difficult to ignite a continuous flaming front in riparian fuels. Riparian fuels are often compacted and moist during all but the driest portions of the year. In addition fuels derived from riparian plants seem to decay and mineralize more rapidly than more combustible upland fuels. For these reasons it is difficult to conduct prescribed burning in stream corridors during the dormant season. During the growing season stream corridor herb layers are populated by an abundance of succulents and other plants which tend to stifle ignition and impede fire spread (Wade and Lundford, 1989).

Studies of birds and oak savannas have emphasized within-patch effects of prescribed burning. Overall, it is clear that bird communities of oak savanna reflect the transitional status of this vegetation type. Blue-wing warbler, prairie warbler, yellow-breasted chat, and scarlet tanager occupy the tier habitats of Ozark woodlands. Most bird species characteristic of oak savannas also have affinities with either prairies or forests.

Effects on Aesthetics

The principal effect of prescribed burning on aesthetics can be summarized in one word: **contrast**. Contrast, or change from the pre-burn landscape, may be positive or negative depending largely on personal opinion. What may be judged an improvement in scenic beauty by one may be considered undesirable by another.

Many of the undesirable impacts are relatively short term and can be minimized by considering scenic qualities when planning a burn. For example, the increased turbulence and updrafts along roads and other forest openings will cause more intense fire with resulting higher tree trunk char and needle scorch. Generally, the more immediate unfavorable impacts such as smoke and ash, top-killed under-story plants, and a blackened forest floor are necessary to achieve two major benefits - increased visual variety and increased visual penetration. Variety or diversity in vegetative cover will create a more pleasing, general visual character to the stand. Similarly, scenic qualities of the forest can be better appreciated if the stand can be made more transparent. An example is the reduction of an under-story buildup along a forest road that will permit the traveler to see into the interior of the stand, perhaps to a landscape feature such as a pond or interesting rock outcrop. The smutty appearance of the ground will "green up" fairly quickly. Any scorched needle will soon drop and not be noticeable Flowers and wildlife will increase.

The direct and indirect effects of prescribed and wild fire on the physical resources (Soil, Water, and Air) are discussed in previous chapters.

Cumulative Effects

The most noteworthy cumulative effect of frequent fire on forested landscapes is the development of a highly diverse herbaceous layer composed primarily of native grass and forb species. This is correlated to the top-kill of small stem tree and shrub species and the resultant increase in light penetration to the forest floor (Huthinson and Sutherland, 2000).

Repeated fire (a restored fire regime) will favor primarily oak and hickory reproduction over that of many competing shade intolerant species on upland sites. In areas targeted for fire restoration the long term effect of fire will be the development of a stock of repeatedly top-killed but vigorous tree seedlings and saplings capable or recruitment into the canopy. Visually these stands will have an open appearance with a well developed herb community and an abundance of tree seedlings (Huthinson and Sutherland, 2000).

The herbaceous response of forested stands is directly proportional to light penetration to the forest floor (assuming all other factors are present). It is likely that in many areas prescribed fire alone will not be sufficient to restore woodlands or meet other objectives. In such cases mechanical treatment (harvest or chainsaw felling) would be required to meet objectives stated in this document. The effects of these activities are similar to other silvicultural activities discussed elsewhere in this document. However, when taken together the long term effect of burning in mechanically treated areas is not significantly different from that of non-mechanically treated areas. Some differences in overstory mortality and soil, water, and air impacts are typical of fires in logging debris in the short-term. These impacts are short-lived.

Regardless of the proposed action chosen, fire will be administered in both the growing season and the dormant season within existing regulations to minimize damage to soils, air, water, desirable vegetation, TES, recreation resources, cultural resources, and species of viability concern.

Alternative W—No Change to the 1994 Plan

Wildland fire suppression
Wildland fire suppression strategies will remain unchanged. All wildland fires will be suppressed. The average visitor will notice no change to the overall fire management strategy. Approximately 150 acres of wildland fire per year can be expected.

Wildland Fire Use

Wildland fire use will not occur except in the Core Areas. All fires will be suppressed by the most direct means possible, considering firefighter and public safety. However, in the Core Areas, fires may be allowed to burn to existing boundaries within predetermined parameters.

Prescribed Fire

Prescribed fire will remain unchanged. Approximately 500 to 1,500 acres will be prescribed burned annually for leaf litter reduction and scenery improvement in developed recreation areas, and for the maintenance of open-lands. The current fire management strategy for the Elk and Bison Prairie and the South Bison Range will remain unchanged. The average visitor will notice no change to the overall management strategy.

<u>Exceptions or Changes under Alternatives X & Y</u>

Summary

Under these alternatives fire will play a significant role in the over all vegetation management strategy for LBL and in some areas may be the primary tool used to accomplish both plan and project objectives. Recognizing the natural and imperative role of fire in ecosystems and continuing the current fire management strategy and expanding it in the following areas:

- Decreasing aggressive wildland fire suppression with a shift to Minimum Impact Suppression Tactics (MIST);
- Allowing onset of Wildland Fire Use;
- Attaining an increase to about 10,000 acres of prescribed fire use annually, gradually over the planning cycle with a shift in program emphasis from burning to maintain open grassland and to reduce leaf litter accumulation in developed recreation areas toward prescribed fire use in forested settings. The primary emphasis will be placed on re-establishment of historic fire regimes for ecosystem restoration.

Wildland Fire Suppression

Under these alternatives, strategies will shift toward the use of MIST to reduce the negative impact of fire suppression where possible. MIST should not be confused with Wildland Fire Use, which is allowing a naturally-caused fire to burn within predetermined parameters. The premise of MIST is to reduce the impact and expense of wildland fire suppression by using existing barriers to prevent fire spread, such as roads, streams, and changes to a less flammable vegetation type (e.g., from a dry field to a damp woodland or wetland rather than to aggressively construct fire-lines). In appropriate situations wildland fire may be allowed to burn to an existing barrier or may be allowed to be extinguished by precipitation.

The public will notice an increase in the size of the areas burned by some wildland fires and fewer dozer or fire plow lines. Snags and hollow trees may still be removed from existing fire lines by chainsaw or dozer in advance of a wildland fire, and low impact hand-lines or fire retardant foam lines will replace dozer-lines. However, some aggressive tactics will still be necessary to ensure public and firefighter safety and for resource protection.

The area burned using MIST could increase from around 150 acres (existing level) to as much as 1,000 acres. However, it is difficult to determine the ultimate annual acreage burned using MIST because of the inherent variables involved.

Wildland Fire Use

Allowing some naturally-caused fires to burn will be considered when an approved operating plan is in place. Currently, about 50 percent of the wildland fires on LBL are from unknown or miscellaneous ignition sources; however, none of these fires has been used to date. Under this alternative some wildland fires will be allowed to burn within predetermined parameters. The premise of this concept is that fire should be allowed, where possible, to play its natural role in ecosystems. The increase of open conditions created with this alternative will actually create the potential for more natural, low-intensity wildland fires, thus allowing the opportunity to use these natural wildland fires.

Prescribed Fire

Under these alternatives, prescribed fire use on LBL will increase gradually but significantly over current levels from 1,500 acres to a range of 5,000 to 10,000 acres annually.

By capitalizing on expanded burning windows, a gradual increase in the experience levels of fire personnel, and local partnerships, LBL will gradually expand the existing prescribed fire program from the maintenance and enhancement of openlands (primarily in native warm season grasses) and recreation areas toward prescribed fire use in wooded systems. The primary objective will be the reintroduction of fire as a key ecosystem process in two selected demonstration areas with a combined total of about 8,000 acres. Prescribed fire will continue to be used in open lands and recreation areas, as well as in support of and to augment other vegetation management opportunities. The exact acreage of prescribed fire use may depend on many factors so a range of acres is appropriate for discussion of the program on an annual basis. However, at estimated capacity toward the end of the planning period the yearly average should approach 10,000 acres.

Burning should begin with an increase to about 5,000 acres over the first five years. Over the next five years (years 5-10 of the planning cycle), burning opportunities should begin to expand allowing for the addition of larger blocks of land to the annual fire management plans. By year 10 of the planning cycle LBL should burn roughly 10,000 acres/year for hazardous fuels reduction, restoration of ecological processes, scenery improvement, leaf litter reduction, and maintenance.

In wooded areas treated with prescribed fire the public will notice a significant shift in the structure of the forest. In general, walking and hiking in the woods will be easier due to removal of accumulated sticks, logs, and brush. They should also notice an increase in the number and diversity of herbs (mainly grasses) on the forest floor as the number of trees is decreased. Many areas will become more open and park-like, facilitating uses such as wildlife and nature viewing, camping, hiking, and hunting. Users may also notice an increase in the density of snags and living den trees, and associated wildlife species such as pileated woodpeckers, Carolina chickadees, and squirrels. Within open lands and recreation areas visitors will notice no change but may see woodlands adjacent to some of these areas appear more open and park-like. Visitors will see that at certain times of the year large areas of LBL have been burned; leaf litter will be removed and tree trunks may be blackened by fire. They may also see smoke plumes from large fires and smoke may impact some uses at certain times. Roads that are used as fire lines may be temporarily closed to public use.

Historically, much of LBL burned often. Estimated fire return intervals range from one to three years in grass-dominated areas prevalent before European contact, to five to 12 years in wooded systems with only the most mesic and barren areas being insulated from frequent fire. The entire area falls into Fire Regime 1 in the national hierarchy. This history of frequent fire is reported to be as old as 6,000 years and has played a significant role in the development of a regionally adapted flora and fauna that depends on the continuance of fire use for sustainability and health. Mathematically, these fire return intervals indicate that in purely ecological terms prescribed fire should be used on up to 50,000 acres of LBL annually, an amount above our current capacity.

The factors limiting the implementation of a prescribed fire program are primarily logistical given public acceptance and support. Logistical problems include the availability of qualified personnel and specialized fire equipment, the availability of funds for implementation, and the availability of time periods within predetermined weather and policy parameters, or windows in which to conduct burning. Of these, the most limiting is the window.

Many things affect the size of the burning window, but the primary constraint on window size is weather, or specifically the effect of weather on the fuel available for combustion. As a general rule, if weather conditions are constant (and dry and windy) over a large area, open areas will dry to the point that they are available for combustion faster than areas that are shaded. Connected to this premise is that the more open a woodland is, the faster it will dry. The effect of this condition on the burning window is an increase of window length directly related to recent past fire history because fire removes or kills small shrubs and trees in the understory that shade fuel. So an area that has been recently burned (within the last three to five years) will have a slightly longer window than an area with no recent fire history. An area with a recent history of several fires will have a longer window still.

The current window is approximately parallel to the number of acres burned annually with the qualified personnel available, and occurs on about 14 to 20 days (an estimate) in the months of March and April. It is anticipated the number of acres burned annually will gradually increase, with an increase in window length and availability of qualified personnel, as funding is not expected to be a limiting factor with respect to prescribed fire implementation.

Exceptions Under Alternative Z

Summary

Under this alternative Wildland Fire Use and prescribed fire will remain mainly static with only modest increases over the current program. Although in some areas it may be the sole tool used to accomplish both plan and project objectives. Use of MIST could contribute to a slight increase in the acreage burned annually. Roughly speaking, however, the overall fire management program on LBL will change little over the existing program by continuing the current fire management strategy with modest changes in the following areas:

- Decreased aggressive wildland fire suppression with a shift to MIST;
- Onset of Wildland Fire Use;
- An increase of about 4,000 to 5,000 acres of prescribed fire use in xeric forest annually, and gradually over the planning cycle.

Wildland Fire Suppression

See narrative for Alternatives X and Y.

Wildland Fire Use

Allowing some naturally caused fires to burn will be considered when an approved operating plan is in place. Currently, about 50 percent of the wildland fires on LBL are from unknown or miscellaneous ignition sources, however none of these wildland fires has been used to date. Under this alternative some wildland fires will be allowed to burn within predetermined parameters. The premise of this concept is that fire should be allowed, where possible, to play its natural role in ecosystems. The general lack of increase of open conditions created with this alternative is not likely to create the potential for more natural, low-intensity wildland fires, thus no increase in the opportunity for Wildland Fire Use is expected.

Prescribed Fire

Under this alternative, prescribed fire use will increase gradually, but significantly over current levels, from 1,500 acres to a range of 4,000 to 5,000 acres annually.

The primary objective will be on the maintenance of the existing fire program by continuing to use fire for the management and maintenance of open lands and developed recreation areas. In xeric wooded systems where fire can be expected to have a significant positive impact on vegetation structure and composition, prescribed fire will be used. Burning should begin an immediate increase to about 3,000 acres within two years and then slowly increase to about 5,000 acres by five years. Over the next five years (years 5-10 of the planning cycle), the focus of prescribed fire use will be to maintain existing accomplishments within logistical boundaries. By year 10 of the planning cycle, LBL should continue to burn 5,000 acres/year for hazardous fuels reduction, restoration of ecological processes, scenery improvement, leaf litter reduction, and maintenance.

The current window on LBL is approximately parallel to the number of acres burned annually with the qualified personnel available, and occurs on about 14 to 20 days (an estimate) in the months of March and April. It is anticipated that there will be no significant increase in window length under this alternative because there will be limited opportunity to use mechanical means to thin trees. Consequently any increases in the number of acres burned annually will remain functionally static with only modest increases. The burning window is expected to remain the key limiting factor for prescribed fire.

3.3.3 Roads Management

Affected Environment

The road system on LBL is comprised of roads under the maintenance jurisdictions of the Forest Service, Kentucky Transportation Cabinet, and Tennessee Department of Transportation (see Table 3.3.3A). There are approximately 736 miles of classified and unclassified roads on LBL, of which approximately 119 miles are classified as Forest Highways, as of April 2004. Maintenance agreements for these Forest Highways are covered by memorandums of agreement with the respective states. The Federal Highway Administration (FHWA) Agreement No. DTFH71-02-X-00024 is with Kentucky and FHWA Agreement No. DTFH71-02-X-00025 is with Tennessee.

When LBL was created, the existing roads and private drives were adapted to meet the needs of the area. Many of these roadbeds date back prior to the Civil War. One of the major changes was the creation of a main north-south route called The Trace. This involved building a good quality paved, two-lane road, generally along the roadbed of the existing north-south roads. Roads to the major campgrounds and lake access areas were upgraded and often paved. Other roads were reduced to lower maintenance levels. Hiking, biking, and horse trails were created, sometimes using old roadbeds.

Engineering (Roads)

There are approximately 736 miles of road in LBL's GIS and INFRA databases. The classified road system, which is in INFRA, includes 449 miles of road (See Table 3.3.3A). There have been approximately 287 miles of additional roads identified that have not yet been evaluated, including some cemetery access roads, farm field access roads, and visitor-created roads. There are five maintenance levels (ML) used by the Forest Service and described in FSH 7709.58, Transportation System Maintenance Handbook. In the classified road system, there are approximately 349 miles of ML 3, 4, and 5 roads, which means a road is suitable for passenger cars. There are approximately 98 miles of ML 2 roads that are suitable for high-clearance vehicles and are seasonally impassable. The ML 2 roads are single-purpose, low volume roads that are normally native or marginal aggregate surface and single-lane design. Less than two miles are ML 1 roads, which are currently impassable, administrative in nature, or are blocked to all traffic. The road density at LBL is approximately three miles of road per square mile of land.

Table 3.3.3A Classified Roads
Source: INFRA database (September 13, 2004)

MAINTENANCE LEVEL	MILES OF ROAD
5*	148
4	71
3	130
2	98
1	2

*Includes 119 miles of roads maintained by KY and TN Highway departments

Direct, Indirect and Cumulative Effects

For all alternatives, density of open roads remains at or near current levels.

New road construction could exist but would be rare under any alternative. Improvements to roads following BMPs may occur under Alternatives Y and Z to support the Nature Watch Demonstration Areas. Improvements or temporary roads may occur under Alternatives X and Y to support the Oak-Grassland Demonstration areas. To support recreational and educational opportunities in Alternatives X and Y, minor road improvements may occur. Administrative roads for timber removal under any alternative would be temporary and mitigated following BMPs. Road access to cemeteries would be maintained as described below. Under each alternative, roads (classified and unclassified) that are no longer needed will be decommissioned as funding is available.

Cumulative effects upon transportation would be indeterminate and therefore not listed.

Proposed changes to the section of Highway 68/80 that crosses LBL are being analyzed under a separate NEPA process. Improvements to Highway 68/80 are project level changes and outside the scope of this planning process.

Soil and Water

The impacts of roads to soil and water are discussed in the Soils Section 3.1.2 and the Watershed Section 3.1.3. These sections describe the need for continued road improvements under all alternatives to protect the resources.

Cemetery Access

As specifically directed in the LBL Protection Act of 1998 (Section 528), access to cemeteries will be ensured for the purposes of burial, visitation, and maintenance. Cemetery access roads will be maintained at the same level as existed when the federal government acquired the land. Although some cemeteries may lie within areas where access fees are charged to the general public, there will be no charge for people wishing to visit cemeteries. If no road exists to a cemetery, it may be necessary to create an access trail for people and maintenance equipment. Trail construction is permitted, but should not disturb the ground.

Recreation

For LBL, the approximately 350 miles of ML 3-5 roads provide for roaded recreation opportunities. These roads represent the best and most heavily-used routes for scenic driving. A scenic byway corridor (The Trace) in Kentucky and Tennessee is managed to provide visitors with enjoyment of outstanding scenery, and natural and cultural landscapes along a well-maintained road.

The area that is visible during the leaf-off season for up to one mile from either side of the road defines the byway corridor. The management focus is on protecting and showcasing the unique scenic, natural, and cultural resources, the elements which were the basis for the corridor's scenic byway designation.

3.3.4 Infrastructure

Affected Environment

Most of LBL's current infrastructure was developed during the late 60s and 70s, and many facilities and utility systems are nearing the end of their design life. At the time of transfer to the Forest Service in 1999, the total estimated deferred maintenance backlog for buildings and developed sites was over $25,000,000. The total estimated deferred maintenance backlog for roads and bridges is split into two categories—paved and unpaved roads. An estimate completed by FHWA in 2002 for paved roads was over $34,000,000. The estimated deferred maintenance backlog for all other roads approaches $1 million. In previous years, several facilities were closed due to declining appropriated budgets, increasing maintenance costs, inflation, and low use. These facilities include part of Rushing Creek Campground, Youth Station, Silo Overlook, and Empire Farm. In order to allow for maximum options, these sites are maintained in a manner to slow degradation of buildings, utilities, and roads until a decision can be made concerning their use, reuse, demolition, or disposal.

Forest Service efforts have focused on standardization of utilities, upgrading the electrical service, improving reliability, and influencing the built environment. This is being accomplished by reducing the deferred maintenance backlog, focusing on restoration activities at heavily-visited sites, primarily for safety and operational efficiencies. The natural features are the focus on LBL with the goal that buildings should blend in with landform and setting. There are 317 structures at LBL, of which 51 have an administrative purpose. The administrative infrastructure includes offices and maintenance facilities. Table 3.3.4A illustrates the number and type of structures on LBL. Other infrastructure items, such as roads, trails, sewer systems, water systems, and recreation components are discussed elsewhere in this document.

Table 3.3.4A Number and Type of structures on LBL

ADMINISTRATIVE BUILDINGS	
Type	**Number**
Office/Maintenance	12
Intern Housing	6
Misc/Storage/Utility	32
Total	**50**
RECREATION BUILDINGS	
Type	**Number**
Developed Environmental Education	38
Developed Recreation	47
Barns	14
Outposts	3
SST/Toilet/Shower&Toilet	52
Wellhouses/Pumphouses	31
Misc/Storage	81
Total	**266**

Effects

There are no known cumulative effects on infrastructure. Under all alternatives, the emphasis will be to reduce the number of facilities, reduce the maintenance backlog, and reduce the operations and maintenance costs at all facilities, sites, and areas to the minimum needed to support the operational and public service needs, taking into account long-range planning, budget, usage, and status. With this being said, that does not completely eliminate the possibility that a new facility would ever be added under Alternative Y, if the above criteria was met. At the same time, if Alternative X is selected, it doesn't necessarily mean that a net gain in facilities will occur. Any direction regarding facilities management at LBL must be consistent with the environmental education, recreation, wildlife diversity, and economic sustainability stipulations of the LBL Protection Act. Over time under all alternatives, the square footage of infrastructure at LBL is expected to decrease slightly.

For Alternative X, the cost to reopen a building that has been out of service as long as some of the closed facilities, can approach the cost to build a new structure. When renovation costs reach a certain percentage of net worth of a structure, new codes and requirements will need to be met. All of these costs will need to be factored into the decision to reopen a long dormant facility or site.

3.4 Socio-Economic Environment and Effects

The social and economic environment is the people aspect of the EIS's considerations. This takes into account the impact that tourism, and recreational and environmental education facilities, programs, and management have on LBL and the surrounding communities. It projects the potential impacts that future demands could have under the different alternatives' management emphases. This section also looks at potential impacts to scenery, cultural resources, and economics of proposed management under each alternative. It further analyzes the potential net benefits to the public for timber harvesting and other vegetation treatments and management.

3.4.1 Recreation and Environmental Education

National Forests provide more than 191 million acres of public land within the United States. National Forests in the Southern Region contribute approximately 13 million acres to the national total and provide unique public land settings for a variety of outdoor recreation and education activities. On the 171,200 acres making up LBL, activities such as the following are available: primitive and developed camping, hunting, fishing, hiking, backpacking, horseback riding, OHV driving, canoeing/kayaking, picnicking, sightseeing, visiting nature centers and historical sites, nature watching, driving for pleasure, and mountain bike riding.

Market Area

Market areas have been established for different National Forests to better evaluate public demand for recreation opportunities. LBL market researchers have defined the local market area as all counties that fall within a 100-mile straight-line radius from LBL's border. Past research has demonstrated that 67 percent of LBL's visits originate from the seven counties surrounding LBL, and another 21 percent originate from areas of surrounding states (Freeman, 1998).

The largest cities within the LBL market area include Owensboro and Paducah, KY; Evansville, IN; and Clarksville, Jackson, Murfreesboro, and Nashville, TN.

Opportunities for outdoor Rec/EE, within the market area, are not limited to LBL. Other public lands such as national parks, national wildlife refuges, state parks, and state wildlife management areas and forests serve to connect and expand the range of opportunities. Information for this section was compiled from the state and federal government web sites of each managing agency.

Kentucky

Within the Commonwealth of Kentucky, several state and federal lands are located within a 100-mile radius of LBL. Federal lands include the Clarks River and Reelfoot Lake National Wildlife Refuges, Fort Campbell Military Reservation, The US Army Corps of Engineer's Lake Barkley Dam visitor center and numerous recreation areas and campgrounds, and the Tennessee Valley Authority's Kentucky Lake Dam recreation areas and campgrounds.

Among the Kentucky state lands are these state parks: Kentucky Dam Village, Kenlake, Lake Barkley, Columbus-Belmont, Mineral Mound, Pennyrile Forest, Lake Malone, John James Audubon, Rough River and Nolin Lake. Also within 100 miles of LBL, the state manages two state forests totaling 15,360 acres and approximately 20 wildlife management areas with a total acreage of about 119,800 acres.

Tennessee

Federal public lands within the state of Tennessee are also extensive within the 100-mile local market area. Federal lands include the Tennessee, Hatchie, Chickasaw and Cross Creeks National Wildlife Refuges, Shiloh National Military Park, and the Fort Donelson and Stones River National Battlefields.

State of Tennessee lands includethe following state parks: Bledsoe Creek, Cedars of Lebanon, Henry Horton, David Crockett, Mousetail Landing, Montgomery Bell, Paris Landing, Nathan Bedford Forrest, Natchez Trace, Pickwick Landing, Chickasaw, Reelfoot Lake and Long Hunter. The state also manages approximately seven areas of state natural, historic, or archeological significance, six state forests totaling 62,400 acres, and 38 wildlife management areas with a total of about 187,200 acres.

Indiana

Federal public lands within the state of Indiana include the Patoka River National Wildlife Refuge and Lincoln Boyhood National Memorial.

State of Indiana lands within the 100-mile radius market area include Harmonie State Park, Lincoln & Colonel Jones Home State Park, and Angel Mounds State Historic Site. State forests include Pike and Ferdinand totaling approximately 10,600 acres. The state manages two historic sites, three fish and wildlife areas totaling approximately 16,500 acres, and two nature preserves totaling nearly 700 acres.

Illinois

Federal public lands within the 100-mile radius include the Shawnee National Forest, the Crab Orchard, Cypress Creek, and Middle Mississippi River National Wildlife Refuge, and Rend Lake operated by the US Army Corps of Engineers.

Illinois has extensive state public lands within the 100-mile radius that include Cave-In-Rock, Dixon Springs, Ferne Clyffe, Fort Massac, Giant City, Lake Murphysboro, and Beall Woods State Parks and Wayne Fitzgerrell, Golconda Marina, and Pyramid State Recreation Areas. There is one state forest consisting of 5,000 acres, one natural area consisting of nearly 13,000 acres, and eight fish and wildlife areas totaling nearly 36,000 acres.

Missouri

Missouri does not have federal public land within the 100-mile radius.

State lands include Big Oak Tree and Trail of Tears State Parks within the 100-mile radius. Also included are three historic sites and 32 conservation areas that include more than 22,300 acres.

Similar to LBL, these state and federally managed lands and areas offer a wide range of recreational and educational opportunities. Levels of development may range from very low to high depending on the type of experiences the managing agency has determined appropriate at the individual area. For example, some areas or sites may be day-use only, some may offer minimal camping facilities, and others may have hotels and other amenities. Several offer activities designed to educate visitors about the natural and/or historical significance of the site or area.

Demand and Trends

Recreational and educational demand is a complex relationship between people's desires and preferences, price, and availability of time and facilities. The evaluation of current and future demand for Rec/EE on LBL is based on recent surveys that identify and quantify the following:

- Estimated number of current recreation/education visits to LBL;
- Participation rates for recreation/education activities within the LBL market area;
- Future activity demand based on projected population growth and participation trends.

The LBL *Visitor Profile Survey* completed in 1998 provides a baseline for estimating current use of recreation and education sites on LBL (Table 3.4.1A). Based on this survey data, developed areas on LBL accommodate approximately 60 percent of the estimated recreation/environmental education (Rec/EE) visits. The remaining 40 percent of Rec/EE visits can be defined as occurring in non-developed areas in the general forest.

Table 3.4.1A - Baselines for Recreation/Environmental Education use on LBL

Type of Site	Current Percentage of Estimated LBL Visits
Developed Sites	**60 %**
Undeveloped Sites	**40 %**
Total	**100 %**

During a typical forest visit, people engage in a variety of Rec/EE activities. Table 3.4.1B lists the most popular activities for visitors. The activities are ranked in order from highest to lowest participation rates based on the 1998 *Visitor Profile Survey* and reflect participation in an activity within LBL. Also listed, as a percentage of visitors, is the main reason individuals or families visited LBL.

According to information in the *Southern Forest Resource Assessment* (SFRA) (Wear, 2002), the top 10 outdoor recreation activities among southerners are walking for pleasure, attending family gatherings, visiting nature centers, sightseeing, driving for pleasure, picnicking, viewing or photographing natural scenery, visiting historic sites, swimming in lakes and streams, and viewing or photographing wildlife. Although many of these top activities do not require vast tracts of land for their enjoyment, Table 3.4.1B illustrates that visitors are relying on LBL to supply these opportunities.

It should be noted that the *National Survey on Recreation and the Environment,* which was used for information in the SFRA, surveyed for outdoor activities in general and not strictly for activities participated in on public lands. In fact, three of the top five main reasons for visiting LBL, according to visitor survey respondents, are not listed in the SFRA. They are fishing, camping, and hunting.

LBL survey respondents ranked fishing as their number one reason for visiting LBL. With LBL being a peninsula between two popular recreational lakes, it would be expected that demand for fishing opportunities will continue to grow. Data from the recreation plans for Kentucky and Tennessee both rank LBL's third most popular overall activity very high. About one third (33.5 percent) of Tennessee's population enjoys warm water fishing (Gardner, 2004), while in Kentucky it is the fourth most popular activity with 43 percent participation (Creech, 2003). It should be noted that Kentucky did not include wildlife viewing or scenic driving in its survey. By the year 2050, the number of days spent fishing in the U.S. is expected to increase by approximately 27 percent (Cordell, 1999).

Table 3.4.1B Participation in Rec/EE activities at LBL and Reason for Visit

ACTIVITY	Percent Participation*	Main Reason for Visit**
Wildlife Viewing/Study	54.6 %	8.1 %
Driving(Scenic)	53.0 %	13.3 %
Fishing(all)	52.5 %	16.8 %
Camping (Family)	37.0 %	14.8 %
Boating(Sport)	30.0 %	2.3 %
Information/ Welcome center	28.9 %	1.1 %
Hiking	28.6 %	3.5 %
Historical Program	23.0 %	1.0 %
Camping (Rustic)	22.8 %	4.7 %
Hunting/Scouting	22.4 %	9.7 %
Picnicking	21.8 %	0.8 %
Shopping	19.1 %	0.1 %
Beach Use	18.0 %	0.5 %
Roadside Exhibits	15.4 %	0.0 %
Swimming	15.4 %	0.4 %
Bicycling(all)	15.2 %	1.9 %
Driving (OHV)	9.2 %	2.5 %
Astronomy	9.2 %	0.7 %
Other	8.7 %	5.4 %
Resource Foraging	7.2 %	0.6 %
Horseback Riding	7.1 %	5.1 %
Historical Site	6.6 %	1.9 %
Reunion/Gathering	6.2 %	2.3 %
Special Event	4.4 %	2.0 %
Target Shooting	3.5 %	0.4 %
Backpacking	3.1 %	0.2 %
Jogging/Running	2.6 %	0.1 %

* 1439 individuals responded to this part of survey
**1118 individuals responded to this part of survey

The second most stated reason for visiting LBL is camping. In both the Kentucky and Tennessee surveys, approximately 20 percent of the respondents indicated that they participated in camping activities. According to National Visitor Use Monitoring (NVUM) data collected at LBL (Aug. 2003) and on forests nation wide, the average length of stay for an LBL visitor in 2003 was 41.1 hours. This exceeds the national average length of stay on Forest Service lands of 19 hours by more than 100 percent. Visitation numbers for the four major campgrounds in LBL peaked in fiscal year1999 and declined somewhat through fiscal year 2003. Weather during the camping season is always a factor in visitation. Factors for declining visitation from 2001 to present may include such things as economic trends, fuel prices or the terrorist attack of September 11, 2001. However, visitation data gathered through July 2004 indicates that visitation is up to levels documented in July 2001. (See tables in Appendix B.4 for more detailed information on visitation to LBL.) This may or may not be a sign of future increases in visitation. However, according to information found in *Outdoor Recreation in American Life* the number of people camping nationally is expected to increase by about 50 percent over the next 50 years. In the South the number is expected to nearly double (Cordell, 1999).

Respondents to the 1998 LBL *Visitor Profile Survey* indicated that hunting and scouting for good hunting spots was the fourth main reason for coming to the area. According to a US Fish and Wildlife Service survey, participation in hunting is on the decline overall (DOI, 2001). However, the same survey states that big game hunting participation, popular at LBL, remained statistically stable between 1991 and 1996. Table 3.4.1B shows that hunting is one of the top 10 activities at LBL. Hunting, both big and small game, remains popular at LBL. Applications for quota deer and turkey hunts have remained relatively stable from 1994 through 2003. For this 10-year period, LBL has received an average of 14,110 quota deer and 4,087 quota turkey hunt applications per year. During the 2003 hunting season, 43 percent of deer hunt and 60 percent of turkey hunt applicants received permits for quota hunts.

Observation by wildlife and law enforcement staff indicates that small game hunting on LBL also continues to remain popular. Hunting participation on LBL is expected to remain stable or increase slightly over the next 10-15 years due to projected loss of private lands for hunting opportunities (Bloemer, 2003). This last statement is further supported by Cordell and Tarrant in the SFRA, which stated, "Unless conditions become more favorable for landowners, the percentage of them permitting public access is likely to continue to decrease…". They go on to state "Thus, the weight of providing for increases in public recreation is likely to fall mostly on public providers, who increasingly face significant budget and capacity constraints (Wear, 2002).

The two activities with the most participation at LBL are wildlife viewing and scenic driving. Approximately 67 percent of the nation's population participated in viewing and learning activities such as visiting a nature center or historic site in 2002 (NSRE, 2003). Viewing and photography activities such as bird-watching, and viewing/photographing other wildlife, wildflowers, and natural scenery were participated in by about 74 percent of the population. The fact that people choose to spend their leisure time participating in learning activities supports the emphasis placed on the Environmental Education program of LBL. In fact, national projections show that visiting historic sites could increase by up to 75 percent by the year 2050 and non-consumptive wildlife uses could increase by 61 percent above 1995 levels (Cordell, 1999). Both Kentucky and Tennessee's recreation plans indicate a move toward more emphasis on environmental education at the state levels. Under LBL's mission and The Protection Act, environmental education is given a high priority. With the added emphasis from the states, the demand for educational programs would be expected to rise, and LBL would be in a position to accommodate the added demand.

Demographic information reveals the aging of the U.S. population. Older adults are becoming a larger portion of the American population. As their numbers increase, demand for less physically-challenging activities such as viewing and photographing wildlife and driving for pleasure may increase as well.

As the population within the local and regional areas continues to grow and the private land base becomes more developed, public lands will increasingly be seen as a place of relaxation and quiet retreat from the built community. Additionally, as forest recreation and education demands grow, visitors and their chosen activities may conflict more with each other, especially on trails, in backcountry, at developed sites, on lakes, streams, and on roads on their way to those environs (Cordell, 2001).

Recreation and Environmental Education Supply

For planning purposes, Rec/EE supply is defined as the opportunity to participate in a desired activity in a preferred setting to realize desired and expected experiences and outcomes. Visitors choose a setting and activity to create a desired experience. Three components of supply are settings, activities, and facilities. At the planning level, the Forest Service manages a supply of settings and facilities.

Settings

The Recreation Opportunity Spectrum (ROS) is a planning tool used to identify and evaluate the supply of recreation settings on National Forests. Four ROS classes and one sub-class are currently inventoried on LBL. These settings include Semi-Primitive Non-Motorized, Semi-Primitive Motorized, Roaded Natural, Rural, and Remote Roaded Natural respectively. See the ROS map in Appendix I for the supply and distribution of these classes. Table 3.4.1C further illustrates the amount of LBL's land that has been identified as offering each of the opportunity types classified in the ROS.

Only four of six possible ROS classifications are available to visitors of LBL. An additional sub-class of Roaded Natural has been added to further delineate recreation opportunities available to visitors. The sub-class has been titled Remote Roaded Natural. LBL's five inventoried ROS categories are explained below in order from least primitive to most primitive experience.

Rural (R) settings represent the most developed sites and modified natural settings on the forest, such as campgrounds, day-use facilities, picnicking areas, administrative zones, and other areas of highly concentrated use. Areas where croplands are adjacent to main travel routes are also in this class due to the obvious human impact on the landscape.

Roaded Natural (RN) settings are located within one-half mile of open roads and usually provide slightly higher levels of development but retain a natural appearance to the casual viewer. Given the high road density of LBL, this is the predominant ROS class found on the area.

Remote Roaded Natural (RRN) is a sub classification of Roaded Natural. This sub class was developed by LBL managers to describe those areas which offer semi-primitive motorized experiences but do not meet the size requirements for the Semi-Primitive class as set forth in the official *ROS Users Guide*. They are at least one-half mile from better-than-primitive roads and at least 1,000 acres in size. These areas are small in size but are scattered widely over the landscape providing visitors a SPM experience in a variety of settings.

Semi-Primitive Motorized (SPM) areas are at least 2,500 acres in size and at least one-half mile from better-than-primitive roads. These areas may be within one-half mile of primitive roads or trails that allow motorized use. Uses in this ROS class would be similar to SPNM but motorized vehicles may be allowed on some of the primitive roads. LBL contains one area that meets these requirements.

Semi-Primitive Non-Motorized (SPNM) areas are generally less remote than primitive areas and can be as small as 2,500 acres in size and one-half mile to three miles from any roads open to motorized use. These settings accommodate dispersed, non-motorized recreation such as hiking, biking, hunting, and horseback riding. One area in LBL meets this requirement.

Table3.4.1C Distributions of ROS Classes on LBL

ROS Class	Acres in ROS Class	Percent of Land Base in ROS Class
Semi-Primitive Non-Motorized	3,266	1.9
Semi-Primitive Motorized	5,388	3.2
Remote Roaded Natural	15,470	9.1
Roaded Natural	138,317	81.2
Rural	7,810	4.6

Also refer to map in Appendix I.

Facilities

Facilities have been developed on LBL to enhance opportunities for visitors to participate in specific activities. Various levels of development have been designed to accommodate the differing degrees of settings and experiences valued by visitors.

The Rec/EE programs of LBL support and manage developed facilities for use by visitors.

Developed Recreation areas on LBL are areas that have received some level of site improvement in support of recreational activities. This category contains any area that requires a significant level of maintenance or capital investment. Trailheads and boat ramps, as well as large family campgrounds, are examples of developed recreation.

Facility-Based Environmental Education (EE) refers to the educational delivery method used at more highly-developed facilities. These facilities have been designed with specific educational objectives in mind. They are staffed by EE personnel during set operating hours and provide the visitor with developed locations in which to seek learning opportunities. The Homeplace-Living History Farm, Woodlands Nature Station, Golden Pond Planetarium and Observatory, and Brandon Spring Group Center are currently the only EE facilities in operation at LBL.

In the following sections Rec/EE will be discussed separately due to the differences in experiences sought by visitors, and the way in which these programs are managed.

3.4.2 Recreation

Affected Environment

Developed Recreation

Recreation sites are developed within different outdoor settings to facilitate desired recreational use. These facilities may include campgrounds, picnic areas, shooting ranges, boat ramps, and OHV areas. “Developed recreation” is the term used to describe these types of facilities.

Developed recreation sites provide different levels of user comfort and convenience. Development Levels range from 1 to 5, with Level 1 representing the most primitive, natural settings with minimal or no site amenities. Level 5 represents the highest level of development with fully accessible facilities. These classifications are described below with examples of sites at LBL classified at each level.

Level 1: Undeveloped recreation sites. Rustic, rudimentary improvements have been made for the protection of the site rather than the comfort of the user. Little active management occurs. LBL currently has no areas inventoried for this classification.

Level 2: Minor site modifications; with no developed campsites and no potable water available. Jenny Ridge Picnic Area is an example of a Level 2 development site with picnic tables and fire rings as the only amenities. In LBL some of these sites may have chemical or vault toilets and trash pick-up for the protection of the site. Examples would be ‘backcountry’ areas such as Ginger Bay, Shaw Branch, and Devils Elbow.

Level 3: Sites such as ‘fee lake access’ areas provide a comparable amount of development for site protection and user comfort. These sites typically include vault or chemical toilets, designated campsites or picnic sites and may provide a developed water source. ‘Backcountry’ areas with developed campsites are included in this classification. Examples would be Birmingham Ferry and Boswell Landing.

Level 4: Offer more user conveniences such as well hardened campsites, flush or vault toilets, high standard roads, some combination of bathhouses and/or options for electric or water hookups. Rushing Creek, Energy Lake, and Cravens Bay campgrounds along with Fenton Lake Access Area are examples of Level 4 campgrounds.

Level 5: Large family campgrounds are examples of Level 5 developed sites on LBL. They offer flush toilets, bathhouses with warm showers, electric, water and sewer hookups, paved roads, and high staffing levels. These areas, typically have amphitheaters, playgrounds, or other amenities. Hillman Ferry, Piney, and Wrangler's Campgrounds are examples.

The Forest Service defines the capacity of developed recreation sites in terms of the number of "people at one time" (PAOT) that a site can support. Currently, there are 90 developed sites managed by LBL to accommodate different recreation activities.
The following tables illustrate the different types of facilities provided across the area and their current capacity in PAOTs.

Table 3.4.2A - Current Capacities and Number of Overnight-Use Developed Sites

Level of Campground	Number of Campgrounds	Capacity (PAOT)
2	11	1,328
3	11	3,256
4	4	1,184
5	3	7,744
Total	**29**	**13,512**

Table 3.4.2B - Current Capacities and Number of Day-Use Developed Sites

Type of Day Use Developed Areas	Number of Areas	Capacity (PAOT)
Picnic Areas	12	588
Shooting Range	1	73
Scenic Drives/Watchable Wildlife	3	1000
Visitor Centers	3	699
Public Swimming Areas	1	100
Total	**20**	**2460**

Table 3.4.2C - Developed Access Points for Dispersed Recreation

Type of Developed Sites	Total Number of Sites	Total Capacity (PAOT)
Trailheads	10	687
Lake Boat Ramps	28	1595
Fishing Docks	3	77
Total	**41**	**2167**

As previously mentioned, developed sites require a considerable amount of maintenance investment. More highly-developed sites, such as level 4 and 5 campgrounds, typically receive higher levels of maintenance than areas of lesser demand and less infrstructure, such as trailheads and shooting ranges. LBL contains more highly-developed sites than the average Forest Service unit.

The public demand for campsites with utility-type amenities is growing and often exceeds supply during peak periods (i.e. holiday weekends and special events). Information gathered from campground staff, comment cards, user meetings, and during public scoping for this Area Plan process indicates many campers desire more accessible sites with water and electrical hookups. As campgrounds are evaluated for upgrading, the potential for additional utility hookups and accessible sites is considered. However, annual occupancy levels do not support the demand for construction of additional developed campsites at this time. Table 3.4.2D illustrates the number and type of campsites found in the development Level 4 and 5 campgrounds of LBL.

Table 3.4.2D - Type and Number of Sites at Level 4 and 5 Campgrounds

Type of Site	Number of Sites
Basic	304
Electric	505
Electric and Water	160
Full Hookup	123
Total	**1,092**

Dispersed Recreation

Dispersed recreation is defined as those activities that occur outside of developed recreation sites such as boating, fishing, hunting, hiking, and biking. However, there are 41 developed recreation sites that facilitate dispersed use of the forest, including trailheads, boat ramps, and fishing piers. The two large lakes on either side of LBL, and five interior lakes, provide fishing, canoeing, motor-boating, and other water-related recreation activities. Table 3.4.2C above illustrates the type and capacity of these sites.

Just over 260 miles of non-motorized trails traverse LBL, including the 68-mile North/South National Recreation Trail and approximately 100 miles of designated equestrian trails. Sections of the North/South Trail are shared by hikers with mountain bikers and horseback riders. Canal Loop Trail system also serves multiple needs, being open for hiking and mountain biking. Other popular trails include the Fort Henry National Recreation Trail system and Hematite Lake trail. Hiking, backpacking, and mountain biking are experiencing an increase in popularity across LBL. In some areas, conflicts exist among the different types of user groups. Table 3.4.2E shows miles of non-motorized trails on LBL by type of use.

Off Highway Vehicle (OHV) opportunities are limited to the Turkey Bay OHV area. This designated area contains many miles of designated routes within an area of approximately 2,200 acres. Off-road riding opportunities are available for visitors utilizing various types of vehicles including four wheelers, motorcycles, motorized buggies, and other four-wheel-drive vehicles (4WD). With the exception of specific special events and permitted activities, Turkey Bay OHV area is the only area on LBL allowing unlicensed all-terrain vehicles (ATV) and motorcycles. Open roads with low maintenance levels have traditionally provided some additional opportunities for street-legal 4WD vehicles to access remote settings.

Demand for off-road experiences is growing nationally and is expected to exceed LBL’s supply by the end of this planning cycle. Illegal riding continues in certain isolated areas, including one classified as being able to provide a SPNM recreational experience.

Requests by disabled users to access other areas with ATVs are growing rapidly (10 requests in 2002; 28 requests in 2003).

Table3.4.2E Type and Miles of Non-Motorized Trails on LBL

Type of Non-Motorized Use Allowed	Existing Miles of Designated Trails
Hiking only	110.8 miles
Horseback Riding only	100 miles
Mountain Biking/ Hiking	54 miles
Paved Bicycle/ Hiking	2.2 miles
Total	**267 miles**

Table3.4.2F Motorized OHV Use Area

Type of Motorized Use Allowed	Area
ATV, 4-wheel drive Vehicles	2,200 acres

Dispersed recreation opportunities are not limited to trail uses only. As shown in Table 3.4.1B, LBL is a popular area for activities from scenic driving to picking berries. Many of these activities require little more than a means of access to the forest or lake. Some activities are not managed by recreation professionals specifically, but forest restoration and wildlife habitat improvement may enhance recreation opportunities.

Viewing and photographing nature while driving one of LBL's hundreds of miles of roads, are very popular activities. Managers must consider this when performing land management activities adjacent to roads and trails. Two areas specifically developed for the viewing of reintroduced species, elk and bison, are the South Bison range and the Elk & Bison Prairie. Thousands of visitors annually enjoy an up-close view of these large mammals, once native to the area.

LBL hosts over 250 days of hunting opportunities yearly. Opportunities for hunting various types of small game, deer, turkey, and waterfowl abound.

LBL also creates many opportunities for water-based activities because it is situated between two large reservoirs. Some of the most popular include fishing, motor boating, and swimming. Access to the lakes is very important for those participating in these activities.

Management of dispersed recreation is becoming more complex as an increasing number of people depend on public land to provide settings for their preferred activities. The number of private owners allowing the public to recreate on their land has been decreasing over time. Increasing demands for off-highway vehicle use, hunting, fishing, and other consumptive recreational activities are likely to bring about more recreation participant/land owner conflicts over time (Cordell, 2001).

Direct, Indirect, and Cumulative Effects

Recreation demand is expected to grow for a variety of dispersed and developed activities. Existing use will increase as recreation demand and the population grows over the next ten years.

Area management could affect recreation by improving or limiting roaded access; constructing or removing recreation facilities and improvements; changing their development level; restricting, prohibiting, or encouraging use; altering the land to make it suitable or unsuitable for use; and changing the landscape setting.

General themes were developed for all alternatives that emphasize different resource management objectives. Alternative W represents the current management alternative and provides a baseline for evaluating other alternatives. Each alternative theme and its management emphasis for the recreational program provide the parameters for redefining the current distribution of recreational opportunities, as well as the level of facility development.

Recreation Opportunity Spectrum

The distribution of ROS classes on LBL is not expected to change regardless of alternative. This is primarily due to two factors: road density and cemetery access.

One of the primary components in determining ROS classifications is distance of the land base from roads. LBL has over 736 miles of roads on its 170,000 plus acres. Due to LBL's high road density the land is predominantly classified under the Roaded Natural ROS setting (see Table 3.4.1C).

In order to change the ROS setting of a piece of land on LBL, it becomes apparent that roads must be decommissioned. However, under section 529 of the Protection Act, the Forest Service must "…ensure access to cemeteries within the Recreation Area for purposes of burial, visitation and maintenance." With over 228 cemeteries dispersed across the landscape of LBL, few roads may be available for closure.

Under all alternatives, land areas located in the Remote-Roaded Natural, Semi-Primitive Motorized, and Semi-Primitive Non-Motorized ROS classes will be managed for semi-primitive recreational experiences. Several of these areas lie within LBL Core areas and management direction for these areas proposes a minimally disturbed ecosystem. Roads within these ROS classes have been classified as primitive. Primitive roads not needed for cemetery or other special access may be obliterated upon project-level review. These road closures would expand visitor opportunities to experience solitude.

Any change in ROS class during the planning cycle is expected to be toward a more primitive setting. For example, there are numerous areas on LBL where croplands fall within the Rural ROS class. If open lands management decisions convert the vegetative structure of current cropland into hay production or native grasses, those acreages would then fall within the Roaded Natural ROS class. However, those decisions are to be made at the project level.

Developed Recreation

Proposed changes discussed in this section are considered optimum for each alternative. Improvements for public health, safety, and accessibility will be top priorities. Budget constraints will also be a determining factor in the amount of improvements that can reasonably be accomplished through the course of the Area Plan implementation.

Alternatives X, Y, and Z allow for a decrease in the number of developed campgrounds. This overall decrease would happen through the reallocation of at least two development Level 2 campgrounds to day-use only in each alternative.

Alternatives X and Y propose a moderate to high degree of change in the development level of some campgrounds while Alternative Z proposes an overall lower development level.

Alternative X proposes improvement of an existing Level 3 campground outside of Turkey Bay OHV area to accommodate users of the area, making the area day-use only. This alternative also creates an overall higher development level of campground throughout the area.

Alternative Y proposes to keep the OHV area open to camping. Opportunities for additional development in Turkey Bay OHV area will be considered at the project level. This alternative proposes fewer campgrounds overall within LBL with lesser development levels. Up to five Level 2 campgrounds may be decommissioned or reallocated to day-use under this alternative.

Alternative Z proposes a similar change in Level 2 campgrounds as Alternative Y, but with more of a shift to lesser developed sites overall.

Table 3.4.2G displays the estimated number of campgrounds and development levels under each alternative. For planning purposes, campgrounds are all developed areas in which overnight camping is allowed.

Table 3.4.2G - Estimated Number of Campgrounds by Development Level

Campground Level	W	X	Y	Z
2	11	7	6	6
3	11	8	10	13
4	4	9	5	2
5	3	3	3	3
Total	**29**	**27**	**24**	**24**

Based on information from LBL's Point of Sale (POS) system, current overall occupancy rates do not justify an increase in the number of developed campsites. However, as stated previously, demand for campsite amenities, such as electric and water hook-ups, is increasing. The number of these more developed site types may increase under any of the alternatives. However, a greater increase would be expected under Alternative X. Alternatives Y and Z may see an increase in site level but only if budget monies are available after dispersed recreation projects have been addressed. These proposed changes may be affected and shaped by drinking water limitations, electrical availability and sewage treatment capacity. Any site additions or upgrades that include water, electric or full hook-ups would be expected to increase the visitation of that particular campground over the course of the camping seasons and into the future, as well as make a return on the capital investment used to upgrade the site.

Increase in visitation to LBL campgrounds could result in two situations. Additional overnights on LBL by campers would add to the economic benefits to the local communities as campers spend their travel dollars at surrounding businesses. Conversely, if private campgrounds' highly developed sites are not being filled to capacity, additional sites at LBL may be detrimental to those particular campgrounds.

Other developed areas in LBL provide for a wide variety of day-use and dispersed recreation opportunities. Table 3.4.2H illustrates the current number and estimated changes for developed day-use sites.

Table 3.4.2H - Estimated Change in Numbers of Day-Use Sites by Alternative

Day Use Developed Areas	W	X	Y	Z
Picnic Areas	12	11	12	11
Shooting Range	1	1	1	1
Scenic Drives/Watchable Wildlife	3	3	4	4
Visitor Centers	3	3	3	3
Public Swimming Areas	1	3	3	1
Shoreline Fishing Opportunities	11	11	11	11
*Turkey Bay OHV Area	0	1	0	0
Total	**31**	**33**	**34**	**31**

* See Motorized Trails area of Dispersed Recreation Section

Dispersed Recreation

Hunting, fishing, hiking, wildlife viewing, backpacking, swimming, and bicycling are just a few examples of dispersed recreational activities. Developed sites may be provided to assure safe and reasonable access to a dispersed opportunity.

Alternatives X, Y and Z (see Table 3.4.2.I) all propose some increase in developed sites that provide access to dispersed opportunities. The increase is estimated to be between 12 and 19 percent across the three main site types providing access to dispersed activities.

Trail head numbers would experience the most proposed growth over all alternatives. Alternative X proposes some additional trail development in proximity to highly developed facilities. Emphasis on dispersed opportunities would result in additional recreation trails and the need for interpretive trails to support the Nature Watch Demonstration Areas proposed in Alternatives Y and Z.

A slight increase is estimated for fishing piers in both X and Y. New docks would probably be constructed as part of boat ramp improvements in areas where fishing success would be most likely.

No net gain in boat ramp numbers is proposed. Alternatives X and Y provide for possible closure of some lesser used, hard to access ramps. Likewise, areas with better access and potential of higher use may be targeted for boat ramp construction, particularly under Alternative X.

Alternative Y would place additional emphasis on upgrading and enhancing more popular boat ramps and adjacent parking areas. However, Alternative Z allows for a decrease in the number of boat ramps on the NRA due to decreased emphasis on development. See Table3.4.2I for more details.

Table 3.4.2I - Developed sites leading to dispersed opportunities

Site type	**W**	**X**	**Y**	**Z**
Fishing Piers	3	5	5	3
Trail Heads	10	13	15	17
Boat Ramps	28	28	</=28	</=28
Total	**41**	**46**	**48**	**48**

Alternatives that emphasize prescriptions which would provide habitat for a diversity of wildlife species would also increase opportunities for hunting and wildlife viewing.

Alternatives X and Y propose the development of Oak-Grassland Demonstration Areas, reintroduction of native warm season grasses, and timber harvest practices that promote habitat improvement. This management direction could potentially increase suitable habitat for bobwhite quail, prairie warbler, and other grassland species substantially above the current direction of Alternative W due to an increase in openland acreage. Likewise the increased amount of edge and open area would allow greater opportunities for viewing wildlife such as deer, turkey, and numerous types of songbirds. Also, Alternatives X and Y provide for additional use of timber harvest and prescribed fire which are expected to increase suitable habitat for demand and non-demand species of flora and fauna; thus, increasing recreational and educational opportunities associated with wildlife in general.

Alternative Z proposes to decrease the management of the resources of LBL. This would result in a decrease in openland acreage and habitat diversity; therefore, decreasing the opportunity for hunting and viewing activities. The reversion of approximately 1,000 acres of openland to early successional forest types would decrease the amount of habitat preferred by species which require openlands for survival; thus, decreasing the diversity of recreational opportunities associated with those species. Alternative Z also proposes a less active management of the General Forest Areas. Less active management would be expected to result in less habitat diversity and fewer types of recreational opportunities associated with the species of demand.

Non-Motorized Trails

All alternatives propose at least a slight increase in the number of non-motorized trails.

Alternatives Y and Z propose the greatest increase in non-motorized trail opportunities, including single- and multi-use trails. Emphasis on new construction of loop trails would be on maximizing use by those seeking shorter hiking and educational experiences. Emphasis would also be placed on increasing mountain biking opportunities by utilizing multi-use trails, creating new, or opening closed sections of existing trails.

Alternative X focuses more emphasis on developed Rec/EE facilities. However, a slight increase in trails is proposed in support of interpretive goals and to enhance visitor experiences within developed areas.

Table 3.4.2J - Estimated increase in non-motorized trails on LBL

Type of Non-Motorized Use Allowed	W	X	Y	Z
	ExistingMiles			
Hiking only	110.8 miles	Low	Mod	Mod/High
Horseback Riding only	100 miles	None	None	None
Mountain Biking/ Hiking	54 miles	None	Mod	Mod
Paved Bicycle/ Hiking	2.2 miles	None	None	None

None = No change
Low = 3-7 percent increase
Moderate = 8-12 percent increase
High = 13-20 percent increase

Motorized Trails

Turkey Bay OHV Area is the only portion of LBL that allows unlicensed off-road vehicle riding. None of the proposed alternatives recommends the expansion of Turkey Bay or OHV use outside of its boundaries. All alternatives do, however, make rider education about resource sustainability a priority.

Riding in the OHV area will be done on designated routes in all alternatives. Turkey Bay has traditionally been an open riding area, but resource sustainability issues, coupled with the growing number of riders, has made it apparent that this open riding is no longer appropriate for the area. Alternatives X and Y further provide for policy changes and/or the closure and rehabilitation of trails or areas that prove to be unacceptably impacted. Furthermore, use of certain types of vehicles may be prohibited in areas where monitoring proves they are extremely detrimental to the resources of the area.

Alternative X proposes that Turkey Bay OHV area be re-allocated to a ‘day-use’ only facility. Camping in the area would be prohibited. The alternative also proposes that either an existing campground be improved to accommodate displaced overnight users, or a new campground be developed outside the Turkey Bay area boundaries. This proposal would be expected to provide increased riding opportunity in the OHV area during periods of high water when flooding limits the number of camping spots available for use. It is also expected to improve safety and decrease user conflicts by eliminating the crowded situations which occur in the camping areas during times of peak visitation. Increased visitation at other campgrounds would also be anticipated. Transportation of riding equipment from an outside campsite to the OHV area could be troublesome for some users once they have set up a campsite. This problem would be taken into account through improvements to day-use facilities at Turkey Bay.

Alternative Y would propose that the Turkey Bay OHV area remain open to camping. Development of more improved camping opportunities than currently exists is possible. However, analysis of the appropriateness, type and size of camping development, inside or outside the area, is beyond the scope of this plan. Designated sites, within the area, would be expected to improve safety and reduce visitor conflicts.

Alternative Z is the most restrictive of the alternatives proposed. It would allow for ATV and motorcycle use only. Larger 4WD vehicles and motorized buggies would be prohibited. Camping would remain as is currently allowed. Implementation of this alternative would be expected to decrease riding opportunities for larger 4WD vehicles, but increase safety by eliminating conflicts between large and small vehicles.

All alternatives recognize the need to reduce the amount of impact OHV use has on the environment. Through collaboration with resource managers and user groups in educating the riding public and rehabilitating damaged areas, all alternatives seek to accomplish sustainability. Further analysis of past and anticipated future impacts by alternative are located in the Soils, Air and Water Section of this EIS.

3.4.3 Environmental Education

Affected Environment

Environmental education at LBL is an integrated program targeted at helping individuals become aware of their relationship with the natural, physical, and cultural resources of the area while supporting stewardship of these resources through action. LBL's Environmental Education program strives to provide the most effective methods for getting these messages to visitors. The two primary delivery methods utilized to reach visitors of varying interests are facility-based and non-facility-based. Similar to developed and dispersed recreation, these methods are not exclusive of one another but are integrated into the whole of the educational program. Each delivery type is discussed in more detail on the following pages.

Facility-Based Environmental Education

Facility-based EE refers to those educational programs, activities, and messages presented at the highly-developed educational facilities. These facilities are staffed by EE personnel during set operating hours and offer a range of educational delivery methods. They accommodate both formal organized groups (schools and scout troops, for example) and informal recreational visitors (families and individuals).

Developed facilities offer specific locations at which visitors may receive educational and recreational information in a structured setting. Highly trained staff can: 1) provide a level of knowledge about LBL's resources which may not be communicated as thoroughly or holistically through the non-facility-based segment of the overall EE program; 2) facilitate personal interactions by visitors with the resources; and 3) illustrate and provide examples, ideas, demonstrations and behaviors that can be utilized and practiced when visitors return home. A variety of facility types and diversity of program themes strive to appeal to the varying interests of LBL's users while providing a comprehensive picture of the overall resource story. Opportunities to interact with staff at the facilities seek to strengthen novice visitors' curiosity and energize the more initiated outdoor enthusiasts' interests. One-on-one interactions also increase the potential for motivating visitors to take personal actions with regard to resource stewardship.

There are six EE facilities on LBL. Four of the six facilities are currently in operation. Empire Farm and Youth Station have been out of operation since 1994. Developed facilities currently serve as the cornerstone of the overall EE program. Their high visibility and easy access to knowledgeable staff often make them popular catalysts for self-guided activities among visitors. Personnel at these facilities also become the developers and suppliers of non-facility-based programs in LBL.

Three of these facilities offer day-use experiences for those visitors seeking to learn about the natural and cultural history of the area.

The **Golden Pond Visitor Center and Planetarium** offers a variety of astronomy-based programs in its 81-seat domed auditorium. Visitors are also taken on a virtual tour of the night sky with the help of a computerized star machine. Another popular attraction at the visitor center is a historical timeline of LBL from prehistoric human occupation to present. An on-site observatory also provides opportunities for special night time programs.

The Homeplace – A Living History Farm (Homeplace) offers visitors the opportunity to experience the lifestyles and customs of life between the Cumberland and Tennessee Rivers during the 1850s. A setting of farm animals, antique furnishings, historic log buildings, and traditional activities re-creates the life of a mid-19th century farm family. Interpreters, attired in period clothing, demonstrate agricultural and domestic skills, and social life and customs of the men, women, and children of the time.

Woodlands Nature Station communicates the relationship between people and the natural environment. Interpretive staff assist visitors in discovering the interconnectedness of humans and nature. A variety of activities featuring live animal and plant exhibits, hands-on discovery programs, and hiking trails are focal points of the experience.

The wide variety of daily activities and programs at these sites is bolstered by a number of special events and programs held throughout the year. Special events may be held at the facility, such as the 'Hummingbird Festival' at the Nature Station or 'Harvest Celebration' at the Homeplace. Varieties of special staff-led programs originate at a facility and then go to more remote locations for activities. For example, eagle viewing tours on LBL are conducted by Woodlands Nature Station Staff.

Brandon Spring Group Center is the only educational facility at LBL to offer overnight accommodations. Brandon Spring caters to organized groups, making multiple-day visits possible to those seeking a broad range of educational and recreational experiences on and off site.

The level of development for these facilities is high. Day-use facilities offer visitors a high level of comfort with paved parking areas, accessible indoor and outdoor exhibits, restrooms and well maintained trails and grounds. Brandon Spring has dormitory style lodging, full service cafeteria, meeting rooms, and other amenities conducive to a 'developed camp' experience.

Most of LBL's current infrastructure was built during the late 1960s and 1970s, and some facilities are at the end of their design life. The educational facilities offer very specific maintenance challenges with historic log structures, animal housing/enclosures, overnight accommodations, kitchen facilities, and other high-use buildings being part of the maintenance equation. Recent efforts have focused on reducing maintenance backlogs through the updating of heavily visited sites, primarily with safety and operational efficiencies in mind. Educational facilities will continue to require fairly large maintenance budgets to keep them up-to-date and safe for visitor use.

Overall visitation to the developed EE facilities has experienced a decline during the past nine years. A sharp drop was seen for fiscal year 2000 during the management transition from TVA to the Forest Service. This particular decline may be attributed mainly to uncertainty on the part of the recreating public and formal educational groups about the future of the EE facilities. During the four years following the transition there has continued to be variation in visitation numbers. Visitation by school groups has been of particular concern with continued decline, despite program efforts to assist classes in meeting state educational objectives. Possible reasons for this trend may include higher costs of transportation, lower education budgets, greater focus on standardized test performance, and weather-related cancellations at key visitation periods. Appendix B.4 contains visitation charts for Rec/EE programs.

Some available data infers that recreational participation in facility-based learning activities is on the rise. Comparisons by Ken Cordell and Michael Tarrant of the National

Survey on Recreation and the Environment (NSRE) for 1995 and 2000 show upward trends in visitation to nature centers and historic sites (Wear, 2002). The same report places visiting nature centers as the third most popular recreational activity in the south with 53.69 percent of the population participating. Visiting historic sites is eighth in the participation rating at 43.83 percent (Wear, 2002).

Information from LBL's 1998 Visitor Profile Study indicates that approximately 47 percent of recreational visitors participate in an educational activity while at LBL. These activities include visits to the Planetarium, Homeplace and Nature Station. Table 3.4.3A offers a comparison of visitation averages based on totals for the years 1995 to 2003 and 2000 to 2003 by facility type. This offers a quick snapshot of the visitation trends facility managers must use to make management and budgetary decisions.

Table 3.4.3A - Visitation Comparisons of EE Facilities

Facility	Facility Type	1995-2003 Average	2000-2003 Average
The Woodlands Nature Station	Day-Use	45,248	42,786
The Homeplace	Day-Use	50,642	45,259
Golden Pond Planetarium	Day-Use	26,137	24,477
Brandon Spring	Overnight	19,958	18,899
Total		**141,985**	**131,421**

Non-Facility Based Environmental Education

Non-facility based environmental education opportunities are characterized by methods of delivering targeted educational messages to visitors in settings away from a designated EE facility. Interpretive signs, trails, and printed materials are part of this opportunity when not associated with an EE facility. Also, when Forest Service personnel, volunteers, or other LBL personnel lead educational programs, in remote locations or developed campgrounds, it is considered to be non-facility-based EE. This type of educational experience tends to be utilized more by the informal recreational user than by formal educational groups.

This segment of the larger EE program strives to serve as a catalyst to spark awareness of natural resources and an understanding of resource issues in the casual user of LBL's recreational opportunities. It is also an extension of the facility-based programs in that it often serves to connect the educational messages presented at the facilities with various management and resource activities being undertaken on LBL. This increases the number of opportunities for visitors to learn about the natural and cultural history of the area through experiencing it first hand. Use of publications, media stories, signage and printed materials are other outlets that can support self discovery.

Non-facility based learning may take place at an area that has received some level of development such as the Elk & Bison Prairie, an iron furnace site, or trailhead. These sites would usually be described as being similar to a Level 2 recreation site, with development primarily designed for the protection of the site rather than the comfort of the visitor.

Since these sites are not normally staffed and the basic delivery method of educational messages differs from the highly developed EE facilities, they are considered non-facility-based.

Table 3.4.3B - Developed access points for Non-Facility-Based EE

Type of Developed Sites	**Total Number of Sites**	**Total Capacity (PAOT)**
Interpretive Trailheads	2	135
Iron Furnace Sites	2	150
Elk & Bison Prairie Stops	3	185
South Bison Range	1	185
Total	**8**	**655**

In addition to the more obvious sites previously mentioned, non-facility-based educational opportunities exist in many forms and locations. Settings range from the most highly-developed campgrounds to the most remote area of the property. Methods of delivery may be scheduled staff-led tours and programs or roadside exhibits and interpretive signage.

A comparison of four non-facility-based interpretive programs at LBL should help illustrate the diversity of the overall program.

1) Jr. Forest Ranger: This self-directed program is designed for children 5-12 years of age. An activities booklet is provided to assist in exploring LBL and learning more about the water, woods, wildlife and history of the area. The age-appropriate activities may be completed on or off LBL. Upon completion of the activities, the child receives recognition for his/her achievement by receiving a Junior Forest Ranger patch.

2) Passport In Time (PIT) project: Volunteers for these projects participate in an actual archeological dig under the supervision of a Forest Service archeologist. This activity is performed at specific locations over a designated period of time. A PIT project has been completed at the site of Center Furnace site in 2003 and 2004.

3) Respect the Resource: This informational program is designed to educate visitors on the impacts individual actions can have on the environment. A variety of delivery methods may be used, including signs, brochures, or short interpretive talks. Messages may be found on trails, at visitor centers, back country areas, or anywhere else visitor use may be concentrated. As projects are designed and planned, considerations are given to the need for educational messages and the best method of delivering those messages.

4) Campground interpretive programs: These activities are held at the more highly developed campgrounds. They are led by LBL interpretive staff or other resource professionals and are targeted at teaching campers about the natural and cultural resources in the area and where they can learn more about those resources.

Direct, Indirect and Cumulative Effects

The management of the EE program at LBL can affect the opportunities to participate in types of learning activities in several ways. Facilities may be expanded, upgraded or developed, and scenic areas and trails may be maintained or expanded with interpretive objectives in mind. Programs may be expanded, or developed to meet resource protection needs, enhance visitor experiences, or teach school-aged children about the world in which we live. Educating the public about the natural and cultural resources of LBL and the nation is the main goal of any EE program. The key difference in the alternatives is in how this goal is achieved.

All alternatives present differing proposals for the direction of environmental education at LBL. None of the alternatives proposes a net decrease in the EE program but each presents a slightly different emphasis of delivery methods. Alternative W represents the current management alternative and provides a baseline for evaluating other alternatives. Each alternative theme and its proposed emphasis for the educational program provide the parameters for redefining the current delivery focus of educational opportunities at LBL. The differences between alternatives are primarily based on which area of the EE program will be given priority in the determination of where limited program dollars will be spent.

The main consideration in the selection of the EE program is the alternative that provides the optimum mix of educational delivery methods and opportunities to effectively educate visitors to LBL. Table 3.4.3C provides an overview of the types of educational opportunities emphasized by alternative.

Table 3.4.3C - Educational Program Emphasis by Alternative

	W	X	Y	Z
Facility Based EE	**No Change**	**Increase**	**No Change**	**No Change/ Slight Decrease**
Non-Facility Based EE	**No Change**	**No Change**	**Increase**	**Increase**

Facility-Based Environmental Education

Alternative X is the only alternative which proposes more facility-based education than currently exists on LBL. It provides for added emphasis on programs and upgrades at current facilities. Development of additional EE facilities or opening closed facilities is possible under this alternative, but only after a project level market analysis proves the demand and viability of such a venture. Increased overnight capacity for organized groups would be possible under this alternative. This alternative also places additional emphasis on creating a greater diversity of programming opportunities at developed facilities.

Opportunities for formal user group type (schools, scouts, tours, etc.) would increase since these types of groups tend to desire a well-organized, staff-led type of experience. This increase in opportunities may, or may not, lead to increased visitation, depending upon factors already mentioned in the visitation discussion of the EE Affected Environment section. The number of non-formal visitors (families, individuals, etc.) is expected to increase slightly due to additional opportunities provided.

One example of a possible new development is from comments received through public scoping. The comment suggested the development of an interpretive center at the Fort Henry site. This type of development may focus more attention on LBL with the growing number of individuals visiting Civil War sites. However, additional facilities equate to higher levels of operation. The ability to maintain a facility and its operations under increasing budgetary constraints would be an important factor in the determination of new development.

Alternatives Y and Z place less emphasis on facility-based programs than does Alternative X. Neither alternative proposes closure of facilities but allows for potential upgrades in order to provide additional educational opportunities and services for visitors, which is similar to Alternative W.

Alternative Y proposes to increase the emphasis of the non-facility-based programs to the level of emphasis placed on facility-based programs as currently exists under Alternative W. This alternative proposes no change in the current emphasis of the facility-based program, thus creating a more balanced emphasis between the two delivery methods of the overall EE program. A higher level of maintenance and potential upgrades at developed EE facilities would be more likely under Alternative Y than Alternative Z. Also proposed under Alternatives Y and Z is the decommissioning of the closed EE facilities, the Youth Station and Empire Farm. Overall staffing levels would be expected to remain somewhat stable. However, budgetary constraints and increased emphasis on non-facility-based programs may require additional facility staff time in development and implementation of those programs. Formal organized group visitation would be expected to remain somewhat stable under this alternative due to dependence on staff-led programs. Informal visitor use to facilities may increase due to the proposed creation of two Nature Watch Demonstration Areas (see Non-Facility-Based section). These areas would foreseeably encourage visitors to seek more information about their experiences, and the facility staff would be naturally sought out.

A slight increase in visitation may be expected in Alternative Z due to proposed reduction or elimination of fees to EE facilities. However, reduction of revenue from all sources of fees in LBL is also proposed in this alternative making it difficult to anticipate effects. One possible effect may be that fewer budget dollars would be available to facilities due to added emphasis on non-facility-based programs. Over time, this may likely result in a decrease in visitor satisfaction at developed facilities due to less interaction with knowledgeable staff and possible maintenance backlogs from decreased budget availability. This would be expected to negatively affect formal groups and recreational users alike. This decrease may be offset to some degree at Woodlands Nature Station by the interest produced in the Nature Watch Demonstration areas. Staff reduction at facilities would possibly result in reduction of special events offered; therefore, a further decrease in visitation may be expected.

Visitors have indicated their desire for quality staff-led programs in a visually pleasing, well-maintained setting. This has proven especially true of school groups. The alternatives propose varying degrees of emphasis for educational facility programs and management. It is difficult to speculate on how these changes may affect other public and private educational sites within LBL and outside of LBL. If, under Alternatives W and X facility based programs increase and the demands for those types of programs are favorable, visitation at outside sites may be negatively affected. However, if additional visitors are drawn to LBL to participate in the EE program, they may also visit those sites in the immediate vicinity. Likewise, under Alternatives Y and Z, facility-based programs may or may not increase depending upon budgetary constraints. If EE facilities offer less programming and fewer staff, sites outside of LBL may see an increase in visitation if they provide services not offered at LBL, but overall visitation to the region is likely to drop as a whole.

Non-Facility-Based Environmental Education

In Alternative W emphasis on Non-Facility Based programs (delivery of EE programs, activities, and opportunities not directly associated with a designated EE facility) remains the same as current direction.

Alternative X does not propose to eliminate any current non-facility-based programs but this type of EE delivery system would play a secondary role to the developed facilities. This alternative is the same as Alternative W for non-facility-based EE. Educational projects currently being offered such as Junior Forest Ranger and Respect the Resource would not be affected, and an increase in these types of programs may be allowed if budgets permit. The priority for time and money would, however, be toward the developed EE facilities.

Alternative X would also propose eliminating the boundary of the current Environmental Education Area (EEA) in the vicinity of Woodlands Nature Station. This area was originally designated to be a showcase area for environmental education and proper land management techniques. The EEA as it exists under Alternative W has lost most of this emphasis over time for numerous reasons. This alternative proposal is aimed at emphasizing the role of EE throughout LBL instead of focusing on just one area. The portion of the Core Area currently within the EEA would retain its limited hunting status under this alternative. All other land area would be included in the General Forest management prescription.

Alternatives Y and Z would place greater emphasis on the non-facility-based programs than currently exists under Alternative W. The main difference between the two is the level of emphasis. Alternative Y seeks to create more balance in educational opportunities between facility and non-facility-based programs. Alternative Z would place greater emphasis on non-facility-based experiences.

Under both Alternatives Y and Z, existing programs, such as the campground interpretive programs and Junior Forest Ranger Program, may be targeted and funded for expansion. Through this expansion, more diversified opportunities for visitors to learn about LBL's resources would be expected. Through expansion of this segment of the overall EE program, visitors to popular recreation sites may be targeted for delivery of educational activities or messages not currently in place. For example, the Respect the Resource program is already under way within the Turkey Bay OHV area. Messages are directed toward responsible riding practices and why this is important for protection of the resources. Expansion of educational messages to other areas of high use would result in greater numbers of visitors receiving educational messages.

Numbers vary by surveys, but there is no disputing that nature viewing is a popular and growing activity for visitors to public lands and to LBL. According to data gathered in the 2003 National Survey on Recreation and the Environment (NSRE), over 50 percent of the US population enjoys driving for pleasure through natural scenery. Likewise, 31 percent participates in bird watching, 44 percent in viewing other wildlife and 43 percent in viewing wildflowers and natural vegetation. The 1998 Visitor Profile Survey conducted at LBL reports that 55 percent of those surveyed participated in wildlife viewing/study and 53 percent participated in scenic driving.

The popularity of these activities can be utilized as an avenue for delivering environmental education. It has been suggested that land managers should be most concerned with "attracting the disengaged to the outdoors" (Eubanks, 2002). Historically, hunting and fishing were avenues for engaging Americans with the out-of-doors. As hunting recruitment declines in most states, an effective way of engaging more Americans with the outdoors is nature-viewing activities. This engagement of people with nature may be essential to ensure the long-term viability of public lands and resources.

Alternatives Y and Z respond to the growing participation in nature-viewing activities by proposing the creation of management prescription areas that emphasize nature-viewing activities. These Nature Watch Demonstration Areas are actual management prescriptions and are located within the current EEA in the north and the no-hunting area across from South Welcome Station in the south (see prescription map in Appendix I for exact locations). These areas would offer visitors the opportunity to have a closer, more intimate experience with the natural world. Features of the areas may include improved roads, road pullouts, viewing platforms and towers, interpretive trails, interpretive panels, signs, and brochures. They would strive to meet the needs of the 'curious' nature viewer of limited experience as well as those that have slightly more experience and seek these types of opportunities as recreational choices. These areas would provide a focus for the delivery of environmental education activities, programs, themes, and messages.

Due to the uniqueness of these areas, a little more explanation is in order. The following paragraphs offer a more descriptive narrative of the philosophy behind the creation of the Nature Watch Areas.

Not all participants or potential participants in nature-viewing activities have the same desires and skill levels for pursuing their activities. The 'viewer' may be divided into three categories:

- **Curious:** These are visitors who take advantage of viewing opportunities as they arise. However, they do not typically make special plans to engage in viewing activities.

- **Aspiring:** These people are more confident than the curious. Nature viewing activities are important recreational pursuits as shown by their willingness to seek out opportunities.

- **Hooked:** Nature viewing is a major part of these individuals' lives. They may make trips focused entirely on viewing nature and will spend considerable time and money pursuing their desires.

Recognizing the differences among these types of nature viewers provides critical direction for developing the delivery framework for EE in the Nature Watch Areas. "Engaging the disengaged" can be accomplished through well-designed, accessible features that permit visitors a closer, more intimate experience with the natural world. Since the target audience is the "curious" and "aspiring" nature viewer, providing some obvious opportunities that require little knowledge, previous experience, or effort is very important. Results from an unpublished 1992 TVA survey, as reported in TVA's 1994 Plan, identify the most popular species for wildlife viewing at LBL (NRMP, 1994). In order, the species determined to be very or extremely important were:

1) bald eagle
2) deer
3) songbirds and waterfowl
4) shorebirds
5) turkey

These demand species can be utilized to connect the visitor to the surroundings and motivate the visitor to *want* more – more viewing experiences, more information, more learning. This connection is then augmented with education through a variety of techniques such as: interpretive panels, signs, displays, "how-to" demonstrations, brochures, staff-led programs, interpretive trails, information sheets, etc.

The Nature Watch Demonstration Areas are a means to an end. The goal is to use the activity of nature viewing to deliver environmental education while providing opportunities to move visitors through an educational process:

- Awareness and appreciation of LBL's natural and cultural histories and resources;
- Knowledge and understanding of basic ecological concepts, interdependencies, and interrelationships;
- Development of skills and abilities to problem solve and to make informed decisions (analysis and synthesis);
- Motivation to take personal actions that support stewardship of LBL's resources.

To further illustrate the connection that must be made between nature viewing and environmental education, consider this as an example:

> Imagine the Elk & Bison Prairie (EBP) with only two signs at the entrance: 1) A sign identifying the area as the Elk & Bison Prairie, and 2) a sign explaining how to purchase a token and gain entry into the Prairie. No other signs are found at the entrance, as well as no brochures, no information sheets, no Bugle Corps volunteers, no staff-led programs/tours, and no interpretive stops/displays in the Prairie.
>
> A visitor who enters may still have an enjoyable and memorable experience viewing buffalo and elk, but what learning/education has occurred? Will the visitor know that the EBP is a re-created (and a continuing restoration project) oak-grassland with native vegetation, that elk and bison were once common species in this area, what an elk bugle sounds like, or that it's possible to volunteer to monitor the EBP and its visitors?

A visit to the EBP is a blended recreational and educational opportunity because the wildlife viewing activity is supplemented and enhanced with a variety of interpretive methods and techniques. The 'hook' (up-close viewable wildlife) is available because the animals are maintained at relatively high densities, are confined within a square mile, are easily accessible by road, and are not hunted. Education is provided as described above through intensified management of resources and visitors.

The Nature Watch Demonstration Areas and the EBP are different than the viewing opportunities that are available throughout LBL. General viewing of wildlife does not necessarily translate into education, particularly when you are attempting to initiate the 'curious' visitor. It is more suited for the 'aspiring' or 'hooked' visitor.

In order to enhance the viewing opportunities of the Nature Watch Demonstration Areas some management changes will be required within their boundaries under Alternatives Y and Z. Compared to Alternative W, three recreational opportunities are affected under Alternatives Y and Z: hunting, wildlife viewing, and backcountry camping. Limited or reduced hunting would be considered on an annual basis depending on habitat degradation due to species density and wildlife management objectives. As discussed previously, national trends indicate a high demand for nature-viewing activities. These demonstration areas have a high potential to increase opportunities for delivery of EE. For example, if only 10 percent of LBL's approximately 2 million visitors go to the Nature Watch Demonstration Areas, the potential exists to reach 200,000 individuals and deliver an education theme, concept, or message.

The main difference between Alternatives Y and Z is boundary locations for the northern Nature Watch Demonstration Area. Based on public input and LBL staff discussions, Alternative Y has been somewhat modified from the draft to reflect increased opportunities for viewing, utilizing existing infrastructure, incorporating additional habitat types, and addressing concerns about hunting animals that may become tolerant of human presence.

Under Alternative Y, the current EEA is expanded to include an area of approximately 1200 acres bordered by Energy Lake Road to the west and the Energy Lake Dam and Lake Barkley shoreline to the south. In addition, this area is also divided into two sections, using old roads into Barnes Hollow from Silver Trail and Mulberry Flat Road to form a section boundary west of Hematite Lake. Alternative Z proposes an additional boundary expansion to include an area of approximately 1350 acres bordered by Silver Trail Road to the south, Road 310 to the west, Road 131 to the north and Road 312 to the east.

Under the expanded area of Alternative Y, the northern area is divided into two sections and managed for different types of nature-viewing experiences (see map):

1) The eastern section will take advantage of existing infrastructure, habitat diversity, and proximity to Lake Barkley to provide viewing opportunities mostly along roads. Visitors will find the former Empire Farm and Youth Station areas utilized for providing scenic lake vistas, one-way drives, and access to viewing blinds and platforms, interpretive displays, or short trails. Structures associated with these former environmental education sites may be incorporated into the area's opportunities and settings, while others may be removed from the setting. In later stages of the planning cycle, consideration may be given to an appropriate area for providing a rustic camping and learning experience for families with young children, youth groups, or novice campers. Hunting pressure in this section would be greatly reduced to facilitate these types of experiences.

2) The western section will provide nature-viewing experiences that require higher levels of viewing skills and increased time investments. Hiking trails and old roads provide access into this section. Visitors find much less infrastructure and "guided" viewing opportunities, but are rewarded with more personal and self-directed viewing experiences. While hunting pressure is also reduced in this area to facilitate nature viewing, wildlife and recreation management objectives may allow for additional hunting opportunities in this section including additional youth hunting, quota bow hunting, or opportunities for physically challenged hunters.

Woodlands Nature Station plays an important role as a "hub" or center for nature viewing and other recreational activities in the northern Nature Watch Demonstration Area. It serves as the primary information source for the season's nature viewing opportunities, provides staff-led programs and activities in the area, and facilitates opportunities for school groups and other organized groups.

Project implementation under Alternative Z would focus along Silver Trail and in Barnes Hollow. Nature-viewing opportunities could be facilitated to provide two different types of experiences: from a paved, well maintained road, and a more rustic, solitary experience gained either by hiking or by unpaved road.

As mentioned previously, there are effects to hunting and backcountry opportunities under Alternatives Y and Z for the northern area. Under Alternative Y, there would be a decrease of hunting opportunity in the extended area from approximately 226-228 days of hunting opportunity to 2-4 days of hunting opportunity. Also in the extended area, no waterfowl hunting would be allowed from the shore, although waterfowl hunters would still be able to access hunting blinds located offshore. Additionally, open backcountry camping would be restricted, but some specialized camping opportunities may be considered in the extended area. The extended area also provides some additional protection for the fallow deer in the area. On the other hand, hunting opportunity may increase in the west section (Barnes Hollow) area. Additional youth hunts, quota bow hunts, or opportunities for handicapped/challenged hunters might be offered. Decisions regarding hunting in these areas will be made annually and are dependent on habitat conditions, wildlife management and recreation management objectives.

The rationale behind the extended area in Alternative Z is to provide a buffer of reduced hunting activity to facilitate increased viewing of demand species, such as deer and turkey, and to provide some protection to individuals that have become somewhat tolerant of human presence. This decreases the hunting opportunity in the extended area from approximately 226-228 days of hunting opportunity annually to 2-4 days of hunting opportunity.

In both Alternatives Y and Z, the currently designated "no hunting area" across from the South Welcome Station in the Tennessee portion of LBL would become a Nature Watch Demonstration Area. In contrast to the northern area, the southern area does not currently contain extensive infrastructure. Fort Henry Road forms its northern border, The Trace borders the east with LBL's southern boundary serving as the border in that direction. The area contains portions of the Fort Henry trail system with Telegraph, Peytona and The Fort Henry N/S connector serving as boundaries to the west. Emphasis for nature viewing activities will center mostly on vegetation such as wildflowers, especially in proximity to Bear Creek. Instead of accessing viewing opportunities along roads, visitors would experience most opportunities by walking or hiking. South Welcome Station would serve as the key facility for providing information about seasonal viewing opportunities, activities, and programs. Bow hunting has been allowed in this area for approximately six weeks each year. This hunting opportunity would probably be decreased to about 2-10 days of hunting opportunity, dependent on habitat conditions, wildlife management and recreation management objectives. Loss of dispersed camping opportunity is expected to be minimal due to the lack of satisfactory campsites in the area.

Visitation to the Nature Watch Demonstration Areas would be expected to increase under both Alternatives Y and Z with a greater increase under Alternative Y. The use of existing roads, once popular visitor destination areas (the Empire Farm and Youth Station sites), and lake vistas is expected to be a popular draw. Repeat visitation is expected to be high with changing seasonal viewing and activities. Alternative Z would not expect to have the same high increase due to presence of fewer habitat types along Silver Trail and access challenges to Barnes Hollow. Visitation to Woodlands Nature Station could be expected to increase, with a larger increase under Alternative Y due to its being more centrally located to the viewing opportunities.

Under both Alternatives Y and Z, an opportunity is created to contrast the viewing opportunities and successes between an area with mostly roaded access in the North and an area with mostly trail access in the South.

Development of the Nature Watch areas would require more intensive management of some of the natural resources. Roads would have to be improved and pull-offs constructed. Trail heads, and in some cases trails, would need to be built. Interpretive signs and displays may be part of the infrastructure. Vegetative management would be intensified in order to create viewing areas, meet habitat requirements and enhance ecological diversity. All these changes would create short and long term effects that would prove positive for the majority of visitors to the areas.

Initially, there is a fairly large budgetary investment in developing the infrastructure necessary for the Nature Watch Demonstration Areas. This is less true for the proposed northern area than the southern area, because roads and trails already exist in potential key viewing areas. Although there are some maintenance costs associated with the necessary infrastructure for a successful viewing area, the costs do not approach the budget needed to maintain and staff a facility. The proposed demonstration areas have high potential to reach increasing numbers of visitors which ultimately also affects the local and regional economies.

3.4.4 Wilderness and Roadless

Wilderness

Congressionally-designated wilderness areas are protected by law and valued for their ecological, historical, scientific and experiential resources. This designation can be considered the most protective of management areas, since only another act of Congress can change a wilderness area’s status. Wilderness areas are generally managed to maintain the area’s natural characteristics.

Natural processes such as insect outbreaks or diseases are allowed to operate as freely as possible and human-made intrusions are very restricted. Only under emergency conditions and with appropriate approvals can mechanical equipment and motorized transport be allowed for the control of fire that threatens life, property, or the wilderness resource. Areas that are designated Wilderness are managed for a Primitive (P) recreation opportunity; however, most forests in the Southern Region do not have lands that meet the actual Primitive ROS criteria. Further management guidelines are set forth in the Wilderness Act of 1964.

Currently, LBL has no designated wilderness or wilderness study areas.

Roadless

Roadless areas are places that have retained or are regaining a natural, untrammeled appearance. Any signs of prior human activity are disappearing or being muted by natural forces. However, the criteria for the Eastern US do provide for an individual roadless area to include no more than one-half mile of improved road for each 1,000 acres.

"The first step in the evaluation of potential wilderness is to identify and inventory all roadless, undeveloped areas that satisfy the definition of wilderness found in Section 2 (c) of the 1964 Wilderness Act" (FSH 1909.12, Chap. 7, Section 7.1). This step is accomplished as a part of the forest planning process. An initial screen for roadless inventory was completed on LBL in 2003. Twelve areas were identified as possibly meeting the roadless inventory criteria. Further analysis identified that only five areas, totaling approximately 11,490 acres, met the initial roadless criteria of having no more than one-half mile of improved road per 1000 acres (Schaefer, 2003).

Of these five areas, only the Devil's Backbone Central area offers a Semi-Primitive Non-Motorized (SPNM) recreation opportunity. All remaining areas are located within the Roaded Natural (RN) ROS class and therefore do not meet the criteria that the area is "conducive to the perpetuation of wilderness values" (FSH 1909.12, Chap. 7, Sec 7.11b, criteria 4). See Appendix C for a more in depth discussion of the results of this analysis.

The 'Devil's Backbone Central' area is approximately 5300 acres in size. In accordance with FSH 1090.12 Chap. 7, Sec 7.11b, the Devil's Backbone Central area was then considered against the remaining roadless inventory criteria. The roadless inventory criteria are:

- The land is regaining a natural, untrammeled appearance;
- Improvements existing in the area are being affected by the forces of nature rather than humans and are disappearing or muted;
- The area has existing or attainable National Forest System ownership pattern, both surface and subsurface, that could ensure perpetuation of identified wilderness;
- The location of the area is conducive to the perpetuation of wilderness values;
- The area contains no more than one-half mile of improved road for each 1,000 acres;
- No more than 15 percent of the area is in non-native, planted vegetation;
- Twenty percent or less of the area has been harvested within the past 10 years;
- The area contains only a few dwellings on private lands and the location of these dwellings and their access needs insulate their effects on the natural conditions of Federal lands.

In brief, the analysis of the Devil's Backbone area indicates that this area does not meet the criteria for inclusion in the roadless area inventory. The main factors in reaching this conclusion include high density of trails with intensive maintenance practices; degree of entrenchment of historical road beds; other extensive evidence of past habitation and land uses; and frequency of low-level military air flights over the area. These and other factors contrast with the values of a wilderness experience. For a full discussion of how the Devil's Backbone Central area addresses the roadless inventory criteria, see Appendix C.

Roadless Area Conservation Rule

On January 12, 2001, the Forest Service issued the Final Rule for Roadless Area Conservation in the **Federal Register**. Since that time, numerous legal challenges have been made to this decision, including a ruling on July 14, 2003 from the United States District Court, Wyoming District, where Judge Clarence Brimmer found the Roadless Area Conservation Rule to be in violation of the National Environmental Policy Act and the Wilderness Act and enjoined its implementation. However, this issue is not settled. Appeals of the Wyoming District Court decision, other litigation, new rulemaking, or new FSM directives could result in a change in direction for inventoried roadless areas.

The Roadless Area Conservation Rule (RACR) would place restrictions on the road construction and reconstruction activities; and the timber cutting, sale, or removal activities that could occur in inventoried roadless areas. 36 CFR 294.12 and 294.13 identify the exceptions where road construction/reconstruction activities and timber cutting/removal activities would be allowed.

The 2001 FEIS to the RACR, however, did not identify any applicable lands in the Land Between the Lakes NRA, and this FEIS (to the LRMP) does not identify any lands that meet the roadless area inventory criteria. Therefore, should the 2001 RACR go into effect, it would not be applicable to any lands within LBL.

Alternatives

Since there are no acres that meet the criteria to be identified as “inventoried roadless areas,” there were no acres to be evaluated further for possible wilderness recommendations. However, both Alternatives X and Y do allow for other areas within LBL to be managed in such a way as to provide the most primitive recreation experience possible. Larger areas within the ‘General Forest Lands’ sub-allocation of ‘Core’ along with areas classified as Semi-Primitive and Remote Roaded Natural (RRN) in the ROS will be managed to provide for semi-primitive recreational experiences. These areas involve approximately 60,574 acres total spread across LBL.

Alternative Z initially called for including wilderness recommendations if any qualified roadless areas were identified. However, since there are no acres that meet the roadless inventory criteria, there will be no wilderness recommendations in this alternative. Like Alternatives X and Y, the above mentioned ‘Core’, Semi-Primitive and Remote Roaded Natural areas would also be managed to provide a semi-primitive recreational opportunity in Alternative Z.

Across all alternatives management of the Devil’s Backbone area will remain relatively unchanged. The area lies within the largest Core Area in LBL and is also the only portion of LBL with an ROS classification of SPNM. These two factors will continue to provide one of the most primitive experiences available on LBL.

3.4.5 Scenery

LBL is an important regional resource because it forms a large, contiguous block of public land in a region where public lands are relatively uncommon. Unlike most national forests and other federal lands in the Southern Region, it has no private in-holdings. Although LBL is not considered mountainous terrain like the Ozarks region, its rolling hills and isolation between two reservoirs give the area some unique visual qualities. The land is 92 percent forested with scattered open land (6 percent), mostly in the narrow branch bottoms radiating from the Tennessee and Cumberland watercourses. Currently, few remnants of the past are readily observable while driving through the property; however, some evidence of many prior activities can be found, including former roads, home places and village sites, logging trails, charcoal hearths, farming, and surface mining for iron ore and gravel.

As a visual resource, LBL is primarily an oak-hickory forest of 157,260 acres. The relatively small amount of non-forested land (10,650 acres) is represented by a variety of open land types -- row cropped fields, hay fields, wildlife woods openings, food plots, managed native grass areas, and power line rights-of-way. This diversity of landscape features is partly due to the natural topography and vegetation of the area, and partly due to active management programs to maintain or enhance vegetative diversity. LBL possesses very few spectacular natural landscape features such as large rock outcroppings, waterfalls, or large flowing streams. However, seasonal beauty can be striking, particularly in spring and fall, and in the winter following occasional snowfalls. Although some visitors to LBL are impressed by the vast amount of forest land, others would prefer more visual diversity and would like to see more open lands, scenic vistas of the lakes and other features, and landscaped roadways.

Less than one percent of LBL's land (1754 acres) has developed facilities for recreation, education, or administration. Developed sites are designed so as not to detract from the visual quality of LBL. These sites are nodes of development and recreation/education concentration to provide access to a variety of settings. Developed sites are spread across the land base with a majority utilizing lakeshore areas for enhancement of visitors' scenic experiences.

Existing Scenery Management

The scenic resources of LBL are currently managed in accordance with TVA's 1994 Plan. That plan established five objectives for the visual management program:

- Manage vegetation to increase sightseeing and wildlife viewing opportunities along selected roadways and around developed facilities;
- Enhance the visual quality of LBL both in naturalness and visual diversity;
- Establish native vegetation including native grasses, wildflowers and flowering trees and shrubs;
- Develop methods and techniques in visual resource management and demonstrate new approaches to other public agencies;
- Demonstrate how visual management on a recreation and educational area can stimulate the local economy.

These objectives apply to the overall area of LBL. Decisions on the desired landscape character and the proper techniques used to achieve it for a particular area of land are made during specific analysis. Guidelines set forth in the 1994 plan are utilized during implementation of land management activities.

Specific measures are stated in the 1994 Plan for the enhancement of scenic viewing. Some of these measures are to take place during timber harvest and other land management activities. Thirteen specific scenic drives are mentioned for consideration for further development. A separate *Sightseeing Master Plan* was developed in the early 1990s in response to visitor surveys and requests for more viewing opportunities. This master plan sets several 'uniform requirements' for the enhancement of sightseeing at LBL. These include actions such as creating scenic vistas, removal of vegetative barriers to sightseeing, creating trail heads for hiking and biking to points of interest, and developing visually pleasing conditions throughout LBL.

Visual Quality Zones (VQZs) act as landscape buffers between land management practices and visually sensitive areas such as along roadways, waterways and trails. Land managers take these guidelines into consideration when practicing management objectives. The VQZs are designed to maintain aesthetic features of the landscape in order to enhance the visitor's experience. VQZs may not be strictly utilized in areas where short-term visual impacts area are acceptable in order to improve the overall scenic quality of an area.

In areas of resource management activities, such as timber harvest, VQZ guidelines have been followed. However, due to budgetary constraints and staff priorities, few of the goals set out in the *Sightseeing Master Plan* have been accomplished. Open areas along the major travel routes have been maintained to allow for visitor recognition of potential hazards from wildlife, wildlife viewing opportunities, and visual diversity. As implementation of the master plan continues, some disturbance to the scenery is expected. However, this disturbance would be needed to move the scenery into the desired landscape character of the selected area. Short-term objectives may be implemented until this overall desired character is established.

Direct, Indirect and Cumulative Effects

The scenic resource is affected by management activities that alter the appearance of what is seen in the landscape. Short-term scenic effects are usually considered in terms of the degree in which a management activity affects the aesthetics of the existing or adjacent landscape. Management activities may change the scenic landscape over the long term if the visual character of the land is altered. Road construction, vegetation management, insect and disease control and utility rights-of-way (ROWs) are examples of management activities that have a high potential to affect the scenery of an area. To a lesser degree, the scenic resource is affected by habitat management, prescribed fire, fire suppression, old growth forest management, recreation and administrative site construction. Changing to a sustainable vegetative type may cause a short-term impact that could take the length of the Area Plan to implement.

In LBL's 1998 Visitor Profile Survey, s*cenic driving* and w*ildlife viewing* were listed as two of the most popular activities participated in at LBL. However, these are not the only activities in which aesthetic beauty adds to the enjoyment of the participant. Therefore, land managers must take into account the scenic impacts to all users when making decisions about the proper tools and methods used in performing management objectives. Scenery management at LBL will continue to focus on creating as few short and long term negative impacts to the visual landscape as possible across all alternatives. Visual buffer zones will be maintained between land management practices and highly traveled roads and trails where practicable unless demonstration or environmental education aspects are to be highlighted.

Under all alternatives open areas along highly traveled roadways will be maintained for safety of visitors, wildlife viewing, and visual diversity. The development of scenic vistas and removal of visual barriers to enhance scenic beauty are also appropriate.

Vegetation management has a great potential to alter the landscape and impact the scenic resource. This impact occurs through both active and passive management. Timber harvest practices can cause long-term effects on scenery. However, not managing timber resources also have effects. Openland size, location, frequency, and vegetation type all have effects on the scenic resource as well. The effects may be positive or negative, depending on their consistency with the desired future condition of the landscape and the visitor's perspective.

Alternatives W, X and Y all propose a variety of land management techniques in order to enhance ecological diversity.

Alternatives X and Y propose more vegetation management than Alternative W to support wildlife diversity and nature viewing. Both also propose some redistribution of selected open lands along with reintroduction of more native grasses. Methods of achieving these proposals would vary, as would the effects to scenic integrity. However, the effects would be expected to be short-term from the techniques used. Long-term effects would be an enhancement of the ability to maintain open areas in a more sustainable fashion and improve wildlife viewing.

Alternative Z proposes passive vegetative management take place on LBL. Under this alternative interior open lands would be allowed to revert to forest unhindered. Other open lands would be maintained for visitor safety, utility rights of way, maintenance, and access. The emphasis would be to move away from cultivated fields to more natural open land vegetation where possible. Woodlands would be allowed to age naturally toward an old growth forest type. Little effects of human intervention would be noticeable on the general landscape.

Wildland fire can have a negative effect on the scenic integrity of an area. Wildfire suppression would be appropriate under all alternatives with some variation. Alternative W would continue current suppression actions which may leave more visual remnants of suppression activities such as dozer-made fire lines. Alternatives X, Y and Z would see a shift to the use of Minimum Impact Suppression Tactics (MIST), which would reduce negative impacts of suppression efforts. With use of MIST existing barriers such as roads, streams, and damp areas are used to reduce fire spread. The public may see more signs of fire but fewer signs of high impact, constructed fire lines. Natural fire will be allowed to burn more under Alternatives X, Y and Z than under W, except when safety of visitors and protection of property are concerned. This would be part of establishing a sustainable landscape.

Prescribed fire is also allowed under all alternatives. Alternative W proposes the least amount of acreage burned under fire prescriptions. Alternative Z is the next most restrictive with an increase over time of about 4,000-5,000 acres annually. Alternatives X and Y propose the highest use of prescribed fire, each allowing for up to 10,000 acres annually. Drifting smoke, blackened vegetation, and charred tree trunks would be the main negative effects to scenery. The intended purpose is to mimic pre-settlement conditions and habitats. The contrast levels and duration vary with fire frequency and intensity. Smoke may last only one day; blackened vegetation usually lasts only a short time, while charring of trees may last somewhat longer. These are short-term effects when considering that it may take the life of the Area Plan to accomplish long-term desired landscape character. Prescribed fire repeated over time produces timber stands with open understories that allow views farther into the forest.

Alternatives X and Y also propose the creation of designated Oak-Grassland Demonstration Areas. In these areas the land would be managed to the extent necessary to demonstrate the landscape character found at the time of European settlement in the area. The demonstration areas would be relatively small in size but would have local impacts to scenery. Visitors would see an open forest with signs of frequent fire as was common in the period. Scenery enhancement for wildlife viewing, wildlife, and vegetative diversity would be expected from this type of management. Techniques used to establish these areas would be as unobtrusive as possible. However, some scenic impacts would be visible during the process of conversion. Negative impacts would be expected to be of a short-term as the landscape character moves toward the desired condition over the course of the Area Plan.

Utility ROWs pose a high potential for affecting scenic integrity over a long period of time. Cleared ROWs do not usually blend well with the surrounding forest landscape. Existing utility corridors will remain open but no new corridors are proposed under any of the alternatives. An opportunity to improve scenery by burial of transmission lines is encouraged, though economically this may be infeasible or unlikely.

Road maintenance affects scenery, especially activities in ROWs. Mowing frequency and timing are factors that can potentially alter the appearance of the landscape. Road construction introduces unnatural visual elements into the landscape and causes contrasts to form, line, color, and texture. Having roads open or closed offers some control over how much of the landscape is seen, especially the forest interior. None of the alternatives presented propose new road construction. Some limited, temporary roads may be built for the purposes of timber harvest or other land management practices. Any temporary roads would be returned to a natural state at completion of the project for which they were constructed unless retained as trail routes. No public use of temporary roads is expected. Implementation of the area wide roads analysis will call for improved scenery as unneeded roads ore obliterated.

Recreation, environmental education, and administrative facilities are not part of the natural landscape. The Forest Service attempts to design facilities that blend into the natural landscape as much as possible. Alternatives X and Y propose the greatest degree of development through potential construction of new facilities, road side pull-offs and trail heads. Alternative W would allow for some further development of sites, while Alternative Z allows for little or no further construction. All alternatives call for the constructed or built environment to be better blended with surrounding features.

Alternatives Y and Z propose the development of nature watching areas in which the landscape character would be conducive to the viewing of all forms of native vegetation and wildlife. Scenic changes would be local but long-term in nature. Trailheads, open areas and pull-offs would be the main landscape changes along with demonstration activities that help the public understand advantages, differences, and professional objectives for active land management.

3.4.6 Cultural Resources

LBL contains approximately 110 known prehistoric and historic archeological sites. Ongoing archeological surveys have covered approximately 16 percent of LBL (some 28,000 acres) over the past 15 years. Three sites have been placed on the National Register of Historic Places: Center Furnace, the Great Western Furnace, and Fort Henry.

Prehistoric Sites

LBL contains the remains of human occupation dating back as far as 10,000 years ago. Evidence from archeological sites suggests that the area has been occupied or at least visited throughout this time period.

Data recovered from archeological sites dating to the Paleoindian and Archaic Periods in the Southeast indicate that a hunter/gatherer economy prevailed during these time periods. Sites from a hunter/gatherer economy can generally be found in all parts of the landscape, from bottomlands to ridge tops. A hunter/gatherer will go wherever natural resources are available and can be exploited for human use. With the introduction of horticulture in the Woodland Period, followed by agriculture in the Mississippian Period, the focus of human use of the landscape shifted to the rich bottomlands of the Cumberland and Tennessee Rivers.

The creations of Lake Barkley and Kentucky Lake inundated a significant part of the landscape around LBL. Archeological surveys conducted before Kentucky and Barkley Dams were built show that the bottomland zone was heavily utilized during the Woodland and Mississippian periods, and that this use continued into the historic period. A decreased usage of uplands during the Woodland and Mississippian periods has been widely observed in the archeological record of the Southeast, and this general trend holds true for the LBL area, as well. The archeological record of LBL was truncated by the creation of the lakes.

The most common archeological sites found in the rolling uplands and hills of LBL date to the Archaic Period (8000 – 1000 BC). Both earlier (Paleoindian) and later sites (Woodland and Mississippian) may be present on the uplands of LBL, but the most intensive prehistoric use of the high ground occurred during the Archaic Period.

Historic Sites

The oldest historic sites situated between the Tennessee and Cumberland Rivers date to the initial occupation of the area by white settlers. Western Kentucky was the last part of the state to be settled. The Jackson Purchase, just west of LBL, was not completed until 1818. Some settlers were occupying homesteads in the land between the rivers as early as the 1780s, but most settlers did not arrive until after 1800.

The first settlers established small farms and used the rivers as their main transportation system. The earliest crude shelters were replaced as soon as possible by single- or double-pen log cabins. Corn was the primary crop with tobacco as the main cash crop.

Very soon after the area was settled, an iron industry developed. The confluence of four factors led to the development of the iron industry here: the presence of iron ore, limestone, plentiful timber to make charcoal, and readily-accessible transportation offered by the rivers. The iron industry in Stewart County, Tennessee reached its highest point in the 1850s. Seven furnaces were located in what is today LBL. They were (from north to south): Mammoth Furnace, Fulton Furnace, Center Furnace, Laura Furnace, Great Western Furnace, Iron Mountain Furnace, and Peytona Furnace. An eighth operation, Empire Furnace, was east of Center Furnace but is currently under the waters of Lake Barkley. The Tennessee Rolling Mill, which processed most of the pig iron produced by these furnaces, was located on the eastern side of the Cumberland River just east of LBL.

The presence of the iron furnaces made this area strategically important for both sides when the Civil War started. The transportation system offered by the rivers is another reason. Western Kentucky and Tennessee were generally pro-southern in sentiment, but native sons served on both sides of the conflict. The capture of Forts Henry and Donelson in February 1862 was the first major success of Union forces during the war. This campaign also marked the beginning of the rise of General Ulysses S. Grant to leadership of all Union forces and eventually to the presidency. Fort Henry today lies below the waters of Kentucky Lake, but some of its outer defensive works can still be seen on LBL. Fort Donelson National Battlefield is directly south of LBL and is managed as a separate unit by the National Park Service.

The disruptions of the Civil War and advancements in the iron industry led to the closure of most of the iron furnaces in western Kentucky and Tennessee during and after the war.

The introduction of coal (and later coke) as preferred fuels, along with the preference for richer and larger sources of iron ore, resulted in the movement of the industry away from this area. The last furnace operating in LBL was Center Furnace, which closed for the last time in 1912.

After the war the South remained predominantly agricultural, while the rest of the country entered the industrial age. The historic occupation of LBL reflected this agricultural heritage. The main cash crop continued to be tobacco, but the local residents took every opportunity they could to produce other goods for sale. These included producing railroad crossties, bricks, whiskey, and any other product that might diversify their earnings potential. However, the basic economy remained rural subsistence farming.

The area that is now LBL was acquired by the federal government in several stages beginning in the 1930s, displacing some former residents as many as four times. The first displacement of these residents occurred in 1937. Through the Constitutional power of Eminent Domain, 65,000 acres were acquired by the US Resettlement Administration and transferred to the US Department of the Interior to be managed as the Kentucky Woodlands National Wildlife Refuge. The residents who were displaced by this action settled in other parts of the area between the rivers or in nearby towns on the eastern side of the Cumberland River.

The second round of displacements came in the early 1940s, when the Tennessee Valley Authority was granted the right to impound the Tennessee River at Gilbertsville, Kentucky by constructing a hydro-electric dam. The resulting lake was named Kentucky Lake and became the western boundary of the "between the rivers" area. Many displaced residents resettled either to the east, along the Cumberland River, or moved into surrounding Kentucky or Tennessee counties.

The third relocation began in the mid-1950s, with the planned impoundment of the Cumberland River by the Corps of Engineers with the construction of Barkley Dam. This formed Lake Barkley on the eastern side of the between the rivers area. During this process, some former residents were displaced for the third time in only two decades.

The final relocation loomed over residents beginning in the late 1950s when the US government initiated a study on the opportunity for a "between the lakes" national recreation area. The final plan to make the entire area a federal entity meant that those residents still living between the rivers, many who had been moved three times, faced the possibility of having to relocate for a fourth time. This time they would be leaving the “between the rivers” area for good.

In 1963 President John F. Kennedy signed the legislation that granted TVA authority and funding to purchase the remaining lands and relocate the residents of all of the lands “between the rivers.” The last resident was moved in 1967, marking the end of private land ownership on LBL.

This lengthy history of displacement, forced relocation, and finally complete removal from the area, was marked by bitterness, resentment, and distrust among many of the former residents. They feel a closeness and relationship with the lands that are LBL because of the sacrifices their families made over the years leading to the establishment of the national recreation area. Even among former residents who live across the country, their interest in and attention to LBL remains as high as it was in 1967.

Effects of the Alternatives

Tribal groups known to use the land between the rivers in prehistoric times include the Cherokee, the Shawnee, and the Chickasaw Tribes. This area was part of the hunting grounds of these three tribes, but not the heartland of any of them. The Cherokee tribe was situated to the east of LBL. The Chickasaw were located to the south, and the Shawnee to the north.

Prehistoric and historic cultural resources are nonrenewable resources. Significant cultural resources (those determined to be eligible for nomination to the National Register of Historic Places) will be protected under all alternatives. Any ground disturbing activity will be preceded by an archeological survey. Any sites discovered will be assessed as to their eligibility for nomination to the National Register of Historic Places. LBL will then formally consult with the Kentucky and Tennessee state historic preservation offices. Consultation will also be done with the federally recognized tribes that are acknowledged to have a historical interest in the land between the rivers – the Cherokee, Chickasaw, and Shawnee. Today there are six separate groups that represent these three tribes. These are the Eastern Band of Cherokee American Indians, the Cherokee Nation of Oklahoma, the Chickasaw Nation, the Absentee-Shawnee Tribe of Oklahoma, the Eastern Shawnee Tribe of Oklahoma, and the Shawnee Tribe of Oklahoma.

Direct and indirect effects of this management plan could result from both natural and human-caused events. Four types of ground-disturbing land management activities have the greatest potential to affect historic resources. These include recreation use, timber management, fire management, and road construction. To a lesser degree, other land management activities can also affect historic properties proportional to their ground disturbing potential.

Disturbance to archeological resources would result from any activity that includes soil disturbance. Timber management can cause soil disturbance from heavy machinery, from dragging logs, or through erosion from the disruption or loss of vegetative cover. Even-aged harvesting may create moderate disturbance for significant properties located near the ground surface or at shallow depths, and such disturbance may occur throughout the entire stand or area being harvested. An uneven-aged harvest or single tree selection would similarly disturb historic properties, but disturbed areas would be dispersed within the harvest area. In either case, skid trails, log landings, and other areas where vehicles are concentrated would receive the greatest depth of disturbance and provide the most significant direct affects to historic properties. Indirect effects could include deterioration of sites and artifacts from erosion and increased site vandalism from increased access and surface exposure of historic sites.

Road or trail construction could cause significant damage to any historic property that might be impacted. However, little road construction is expected on LBL. Survey prior to construction would permit the adjustment of any roads or trails to avoid historic properties and effects; both direct and indirect should be minimal.

Historic properties may be directly and indirectly affected by heat damage to artifacts and sites and from erosion to sites resulting from wildfire or prescribed burns. High temperature wildfires would have greater effects to archeological sites than prescribed burns. Sites of the historic period are most subject to direct effects from fire because many of these properties are more likely to have surface artifacts. Studies show that wildfire, and in some cases prescribed burns, may alter the character and condition of surface artifacts by melting glass, "crazing" lithic and ceramic artifacts, and by burning wooden structures. Prescribed burns could also affect surface artifacts or very shallow sites, but because of reduced temperatures in these types of burns, the affects should be much less than for wildfires.

Recreation management includes both developed sites and dispersed recreation. Direct affects to significant historic resources can result from installation or expansion of recreation facilities. Indirect affects could result from soil erosion and compaction related to visitor use and from vandalism related to increased access to historic sites.

Greater visitor use may lead to an increase in vandalism, littering, and general disturbance to cultural sites under all alternatives. Cultural properties situated in developed recreation areas and along designated trails and road corridors can be signed, monitored, patrolled, and protected. Cultural properties outside these areas are at greater risk.

Pursuant to and in compliance with the terms and conditions of the National Historic Preservation Act, the Archaeological Resources Protection Act, and other federal laws and Forest Service regulations and guidelines, LBL will systematically identify, record, and protect all significant cultural properties located on LBL. This includes all significant historic properties that may be potentially affected by implementation of Forest Service project activities. However, cumulative affects may still result in the degradation of sites and a reduction in the number of intact historic resources over time. The increased visitation to LBL could cause increased damage to sites as the result of increased public access, erosion, and vandalism.

3.4.7 Population and Economy

This summary information is supported by the detailed reporting in Appendix B.14 under the subtitles of "Economic And Local Government Impact Analysis" and "Demographic Changes and Economy Trends." The LBL Analysis Area in Section 3.4.1 refers to a seven-county area. Three counties, Lyon and Trigg in Kentucky and Stewart in Tennessee, fall within LBL boundaries; four more counties in the region include Calloway, Livingston, and Marshall in Kentucky and Henry in Tennessee. Population and economic dynamics depict a rural setting and are changing at a moderate rate within the LBL Analysis Area. Population growth was only three percent in the 1980s and increased to a growth rate of nearly 14 percent in the 1990s (see Appendix B.14, Table 4). The population within LBL's Analysis Area grew at a faster rate than the population of the Commonwealth of Kentucky in both the 1980s and the 1990s.

The minority population in the LBL Analysis Area has remained below 10 percent for the last two decades and was below the state level during this period (see Appendix B.14, Tables 1 and 2). In the year 2000 minorities made up seven percent of the LBL Analysis Area population and 10 percent of the states' population (see Appendix B.14, Table 3). This was a slight gain from 1990 for both areas indicating slight net migration to the LBL Analysis Area and states as a whole. The percent of minority population is below the national average of 13 percent for both the LBL Analysis Area and state. The use of the LBL Analysis Area by minorities may be below national averages but should increase over time if the net migration trend continues.

A major difference exists between the LBL Analysis Area and the state with regard to its rural character of the population. In 2000 the LBL Analysis Area was much more rural, 100 percent rural in three counties and more than 75 percent rural in the Analysis Area (see Appendix B.14, Table 6). Further, the LBL Analysis Area maintained its rural character during the 1990s while the states as a whole realized about a 10 percent decline.

The LBL Analysis Area's economic health, as measured by per capita income, grew at a robust rate during the 1990's--2.7 percent per year--and was equal to the state rate during this period. Even though per capita income kept up with state growth during the 1990s, it was below the State level in 1990 and remained about $1350 below state per capita income in 2000. Unemployment followed a similar pattern. It was seven percent in 1995 which was higher than the state rate of 5.4 percent. It declined to five percent in 2000 but remained higher than the state as a whole.

With a steady income growth rate (see Appendix B.14, Table 7) and a downward trend in unemployment (see Appendix B.14, Table 16), the area economy appears strong and stable. People with increasing incomes and adequate employment are likely to have the time and resources to pursue recreational activities. Federally managed lands can be a prime outlet for many types of recreational activities.

The LBL Analysis Area poverty rate improved over the past two decades and remains below the level of Kentucky (see Appendix B.14, Table 8). It was about two percentage points below the state in 1980 and increased to almost three percentage points below in 2000.

"Female heads of households with children", and "persons per household" are two demographic characteristics that traditionally indicate lower-than-average economic growth in some areas (see Appendix B.14, Table 9). These data in the Analysis Area are better than the data for Kentucky as a whole, and should not be a deterrent to economic growth.

The Analysis Area's economy was very dependent on manufacturing in 1990. This sector continued its dominance in 2000, with 57 percent of its net exports coming from the Manufacturing sector in that year (Appendix B.14, Table 14). As measured by total dollar output in 2000, Manufacturing was about 41 percent of the economy but substantially less if measured by employment—only 20 percent (see Appendix B.14, Table 13). Transportation & Public Utilities; Wholesale & Retail Trade; Finance, Insurance& Real Estate; Services; and Government all gained in shares of total industry output during the decade of the 1990s. "Wood products" maintained its 1.5 percent relative share of economic activity and "furniture and fixtures" gained in importance, from 0.4 percent to 1.1 percent. The "paper & pulp products" sub-sector was not present in the 1990 economy and was of no significance in 2000. The three sub-sectors that make up the wood products manufacturing component of the total Analysis Area economy was about 2.6 percent of total industry output in 2000.

A principle way an economy grows is by exporting goods and services. Most typically, manufacturing activity is thought of as providing most of this export-related activity. It can, however, be a net importer if it imports more of all commodities than it exports. Services and retail trade can be considered "export" industries if significant visitors come from outside the Analysis Area and participate in travel-related activities to bring in new dollars. In this context, tourism could be classified as an export-driven activity.

In general, economies that export more than they import are able to grow faster than those that are net importers. The Analysis Area was a net importer ($64.2 million) in 1990 and the level of net imports increased ($931.0 million) in 2000. The three wood product sub-sectors were examined in more detail with regards to net exports. "Wood products" and "furniture and fixtures" were net exporters in 1990 and increased their net export level to $26.4 million and $19.6 million, respectively, in 2000. "Paper & pulp products" was a net importer in 1990 and 2000.

The LBL area economy and demography reflect a strong rural base. The economy appears healthy but very dependent on manufacturing and not positioned for rapid growth. Population, housing, employment and income continue to increase, which will generate some additional pressure for leisure time activities. The demand for such activities will not be as prevalent as would be expected in a more urban setting.

Direct, Indirect, and Cumulative Economic Effects

The management of LBL has the potential to affect jobs and incomes within its area of influence. Employment and income estimates were determined by using the input-output model IMPLAN (Impact for Planning Analysis). 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.

The database in IMPLAN represents Census 2000 information for 528 industries. On LBL, effects are based on changes in five major forest-level outputs: the amount of timber volume; type of timber product to be harvested; payments to states (counties); Forest Service expenditures; and recreation use (an explanation of how recreation visits were calculated can be found in Appendix B.9, subtitle: "Conversion of Survey Results to Visits and Trips"). For purposes of estimating the socio-economic impact, counties around LBL were selected as the impact area. The input/output analysis is based on the interdependencies of the production and consumption elements of the economy within the impact area.

Industries purchase from primary sources (raw materials) and other industries (manufactured goods) for use in their production process. These outputs are sold either to other industries for use in their production process or to final consumers. The structure of interdependencies between the individual sectors of the economy forms the basis of the input/output model. The flow of industrial inputs can be traced through the input/output accounts of the IMPLAN model to show the linkages in the impact area economy. This allows the determination of estimated economic effects (in terms of employment and income).

Employment

Table 3.4.7A illustrates how the proposed alternatives differ from the current management direction (Alternative W) for potentially affecting jobs in the local economy. Estimated employment changes from the current situation range from a decrease of approximately five percent for Alternative Z to an estimated increase of nearly seven percent in Alternative Y. The recreation program has the greatest potential to affect jobs and labor income in the local economy, followed by wildlife and fish. Timber-related jobs fluctuate between the alternatives as a result of the various levels of timber harvest.

Table 3.4.7A - Employment by Program by Alternative (Average Annual, Decade 1)

	Total Number of Jobs Contributed				
Resource	**Current**	**Alt. W**	**Alt. X**	**Alt. Y**	**Alt. Z**
Recreation	1,076	1,076	1,081	1,135	1,033
Wildlife and Fish	554	554	587	598	533
Grazing	0	0	0	0	0
Timber	127	127	158	150	124
Minerals	0	0	0	0	0
Payments to States/Counties	35	35	39	37	29
Forest Service Expenditures	132	132	134	133	113
Total Forest Management	**1924**	**1924**	**1999**	**2053**	**1832**
Percent Change from Current	**---**	**0.0%**	**3.9%**	**6.7%**	**-4.8%**

Employment impacts are divided into the major sectors of LBL's economy in Table 3.4.7B. For all alternatives, Manufacturing, Services, Retail Trade, and Government are the sectors most affected by Forest Service programs and expenditures. To the extent that an alternative has a commodity program, manufacturing is also affected to a significant degree.

Table 3.4.7B - Employment by Major Industry by Alternative (Average Annual, Decade 1)

	Total Number of Jobs Contributed				
Industry	**Current**	**Alt. W**	**Alt X**	**Alt. Y**	**Alt. Z**
Agriculture	52	52	54	56	50
Mining	21	21	22	22	20
Construction	26	26	28	28	24
Manufacturing	160	160	182	179	153
Transportation, Communication, & Utilities	45	45	48	49	43
Wholesale Trade	75	75	78	80	72
Retail Trade	776	776	798	825	742
Finance, Insurance, & Real Estate	35	35	36	37	33
Services	591	591	607	628	565
Government (Federal, State, & Local)	138	138	144	144	127
Miscellaneous	3	3	3	3	3
Total Forest Management	**1922**	**1922**	**2000**	**2051**	**1832**
Percent Change from Current	**---**	**0.0%**	**3.9%**	**6.7%**	**-4.8%**

Labor Income

Labor income for the first decade for each resource program expenditure is given by alternatives in Table 3.4.7C. Impacts to the local economy sectors are shown in Table 3.4.7D. The current management direction alternative (Alternative W) has $40 million of labor income associated with it. The spectrum of labor income then ranges from $42.8 million for Alternative Y to $37.7 million for Alternative Z. The recreation program, Forest Service expenditures, and the wildlife and fish program consistently contribute the majority of labor income for all alternatives. Alternatives X and Y also contribute more labor income from the timber program compared to Alternatives W and Z. Retail Trade, Services, Government, and Manufacturing are the four industry sectors most affected by Forest Service programs and expenditures for all Alternatives. The range is approximately six percent increase for Alternative Y, to approximately six percent decrease for Alternative Z.

Table 3.4.7C - Labor Income by Program by Alternative (Average Annual, Decade 1; $1,000,000)

	Millions of Dollars				
Resource	**Current**	**Alt. W**	**Alt. X**	**Alt. Y**	**Alt. Z**
Recreation	$19.1	$19.1	$19.2	$20.2	$18.4
Wildlife and Fish	$10.2	$10.2	$10.8	$11.0	$9.8
Grazing	$0.0	$0.0	$0.0	$0.0	$0.0
Timber	$3.3	$3.3	$4.1	$3.9	$3.2
Minerals	$0.0	$0.0	$0.0	$0.0	$0.0
Payments to States/Counties	$1.1	$1.1	$1.2	$1.1	$0.9
Forest Service Expenditures	$6.6	$6.6	$6.6	$6.6	$5.3
Total Forest Management	**$40.3**	**$40.3**	**$42.0**	**$42.8**	**$37.7**
Percent Change from Current	**---**	**0.0%**	**4.2%**	**6.4%**	**-6.4%**

Table 3.4.7D - Labor Income by Major Industry by Alternative (Average Annual, Decade 1; $1,000,000)

	Millions of Dollars				
Industry	**Current**	**Alt. W**	**Alt. X**	**Alt. Y**	**Alt. Z**
Agriculture	$0.5	$0.5	$0.5	$0.6	$0.5
Mining	$0.5	$0.5	$0.6	$0.6	$0.5
Construction	$0.9	$0.9	$0.9	$0.9	$0.8
Manufacturing	$5.5	$5.5	$6.1	$6.1	$5.2
Transportation, Communication, & Utilities	$1.6	$1.6	$1.7	$1.8	$1.6
Wholesale Trade	$2.7	$2.7	$2.8	$2.9	$2.6
Retail Trade	$10.9	$10.9	$11.2	$11.6	$10.4
Finance, Insurance, & Real Estate	$0.8	$0.8	$0.8	$0.8	$0.7
Services	$9.5	$9.5	$9.8	$10.1	$9.0
Government (Federal, State, & Local)	$7.3	$7.3	$7.5	$7.5	$6.2
Miscellaneous	$0.0	$0.0	$0.0	$0.0	$0.0
Total Forest Management	**$40.3**	**$40.3**	**$42.0**	**$42.8**	**$37.7**
Percent Change from Current	**---**	**0.0%**	**4.2%**	**6.4%**	**-6.4%**

Cumulative effects analysis is designed to reveal the context of alternative impacts within the planning area. This is done by comparing total changes in the planning area *with* each alternative to total changes *with* no action. Such a comparison is done by estimating employment and income at the expected end of the forest planning horizon (15 years) and calculating a 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. The analysis is made with employment and income estimates for each alternative remaining at 2000 levels.

The assumption made in our analysis is that the same rate of growth will continue over the 15 years of the Area Plan. The source of the data for these estimates is the US Bureau of Economic Analysis.

Table 3.4.7F shows employment and labor income for the planning area. The first two columns present the 2003 base year and that portion of the base year attributable to use and management of the national forest. The next column shows state and local government projections for 2018. Forest alternative outputs are assumed to be constant over the planning horizon. Included in the projections are employment and income effects attributed to the current direction (or no action) alternative. The remaining columns show the separate effects of each alternative at the end 2018.

What in 2003 accounted for 3.4 percent of all employment will in 2018 account for about 2.5 percent for Alternative W. For the proposed alternatives in the EIS, expected shares of the economy will range from 2.4 percent of the economy for Alternative Z to 2.7 percent for Alternative Y.

Employment changes in 2018 from Alternative W range from – 4.8 percent for Alternative Z to 6.7 percent for Alternative Y.

What in 2003 accounted for 2.6 percent of all income will in 2018 account for about 1.0 percent for Alternative W. For the proposed alternatives in the EIS, expected shares of the economy will range from 0.9 percent of the economy for Alternative Z to 1.0 percent for Alternatives X and Y.

Income changes in 2018 from Alternative W range from -6.4 percent for Alternative Z to 6.4 percent for Alternative Y.

The cumulative effects analysis shows that over time each alternative has a very different effect on employment and income. Alternative X and Y have positive proportionate effects with Alternative Y having almost twice the effect as Alternative X. Alternative Z is the only alternative that would be expected to have a negative proportionate effect on income and employment.

Table 3.4.7E - Cumulative Economic Impacts in 2018

	2003		2018				
				Forest Portion			
Economic Indicator	**Area Totals**	**Forest Portion**	**Area Totals**	**Alt. W**	**Alt. X**	**Alt. Y**	**Alt. Z**
Employment							
Total (jobs)	56,582	1,924	76,714	1,924	1,999	2,052	1,832
% of Area Totals	100%	3.4%	100%	2.5%	2.6%	2.7%	2.4%
% Change from No Action	---	---	---	**0.0%**	**3.9%**	**6.7%**	**-4.8%**
Labor Income							
Total ($ million)	$1,533.0	$40.3	$4,225.0	$40.3	$42.0	$42.8	$37.7
% of Base	100%	2.6%	100%	1.0%	1.0%	1.0%	0.9%
% Change from No Action	---	---	---	**0.0%**	**4.2%**	**6.4%**	**-6.4%**

Revenues and Payments

With the exception of Alternative Z, Forest Service revenues from program activities, which result in payments to states (counties), are expected to increase slightly from the current direction of Alternative W. The magnitude of annual payments to states expected in the first decade is shown in Table 3.4.7F. Under Alternative W, LBL is expected to distribute about $1.6 million per year to surrounding counties. Alternatives X and Y would be expected to produce a $1.7 million payment. Alternative Z would produce approximately a $1.3 million payment to Lyon and Trigg counties in Kentucky and Stewart County in Tennessee.

Table 3.4.7F - Forest Service Revenues and Payments to Counties (Annual Avg, Decade 1; $1,000,000)

Forest Service Program	Current	Alt. W	Alt. X	Alt. Y	Alt. Z
Recreation	$3.5	$3.5	$3.8	$3.6	$3.0
Wildlife and Fish	$0.0	$0.0	$0.0	$0.0	$0.0
Grazing	$0.0	$0.0	$0.0	$0.0	$0.0
Timber	$2.5	$2.5	$2.7	$2.6	$2.2
Minerals	$0.0	$0.0	$0.0	$0.0	$0.0
Soil, Water & Air	$0.0	$0.0	$0.0	$0.0	$0.0
Protection	$0.3	$0.3	$0.5	$0.5	$0.1
Total Revenues	**$6.3**	**$6.3**	**$7.0**	**$6.7**	**$5.3**
Payment to States/Counties	**$1.6**	**$1.6**	**$1.7**	**$1.7**	**$1.3**

Land Between The Lakes Current Role

Finally, Table 3.4.7G illustrates the percentage contribution of LBL's current management program (Alternative W) to the area's economy. LBL is associated with 2.7 percent of the total local economy's jobs, and 2.0 percent of the labor income. Manufacturing, Services, Retail Trade, and Government are the sectors of the economy that show the most benefit from the forest's activities.

Economically speaking, commodity-oriented alternatives have a greater role in producing impacts on the economy. However, substitutions may occur in certain sectors, such as those related to the timber program. Non-government owners could supply local mills with the timber demanded by the local economy. Therefore, there would likely be no loss of jobs or income from a reduced federal timber program.

Although the effects of the recreation, and wildlife and fish programs are relatively small compared to the overall LBL economy, they are the most significant contribution of all of LBL's programs. In total, the current direction shows a 2.7 percent share contribution to the total local economy's employment and 2.0 percent of labor income.

Table 3.4.7G - Current Role of Forest Service-Related Contributions to the Area Economy

	Employment (jobs)		Labor Income ($ million)	
Industry	**Area Totals**	**FS-Related**	**Area Totals**	**FS-Related**
Agriculture	5,728	52	$54.2	$0.5
Mining	658	21	$29.3	$0.5
Construction	6,193	26	$191.4	$0.9
Manufacturing	13,198	160	$557.4	$5.5
Transportation, Communication, & Utilities	3,196	45	$109.2	$1.6
Wholesale Trade	2,278	75	$77.1	$2.7
Retail Trade	12,668	776	$199.9	$10.9
Finance, Insurance, & Real Estate	2,859	35	$66.9	$0.8
Services	12,427	591	$301.6	$9.5
Government (Federal, State, & Local)	12,458	138	$402.7	$7.3
Miscellaneous	281	3	$2.0	$0.0
Total	**71,944**	**1,922**	**$1,989.9**	**$40.2**
Percent of Total	**100.0%**	**2.7%**	**100.0%**	**2.0%**

Values

There are many values associated with National Forests that cannot be expressed in monetary terms. Following are treatments using both monetary and non-monetary values. Many values are highly personal and subjective in nature.

Present Net Value of the Alternatives

Table 3.4.7H shows the estimated benefits, costs, and present net value (PNV) by alternative. All figures are in 2000 dollars. The benefits include market values and non-market estimated values. Market values include those values where the Forest Service receives money for timber, minerals, range, special uses, etc. Non-market values are estimated values for amenities such as wildlife and recreation.

3.4.7H Cumulative Decadal Present Values of Costs and Benefits (in Thousands of $)				
	Alt. W	**Alt. X**	**Alt. Y**	**Alt. Z**
Cumulative Total Present Net Value	$2,030,444	$2,148,870	$2,334,236	$1,959,108
Percent Difference compared to Alt. W	0	+5.8	+15.5	-3.5
Present Value Benefits by Program				
Range	$0	$0	$0	$0
Timber	$3,039	$3,139	$3,233	$1,861
Minerals	$0	$0	$0	$0
Recreation	$510,801	$524,822	$543,839	$486,646
Wildlife	$1,679,873	$1,784,178	$1,950,434	$1,603,722
PV of Benefits	**$2,193,713**	**$2,312,139**	**$2,497,506**	**$2,092,229**
Present Value Costs by Program:				
Range	$0	$0	$0	$0
Timber	$3,183	$3,394	$3,394	$3,104
Roads/Engineering	$9,796	$9,796	$10,776	$9,796
Minerals	$0	$0	$0	$0
Recreation	$119,541	$119,501	$119,716	$95,405
Wildlife	$20,238	$21,094	$19,900	$16,348
Soil, Water, Air	$1,006	$1,217	$1,217	$644
Protection/Forest Health	$1,773	$1,773	$1,773	$1,330
Lands	$831	$831	$831	$831
Planning, Inv., Monitoring	$6,901	$5,663	$5,663	$5,663
PV of Costs:	**$163,269**	**$163,269**	**$163,270**	**$133,121**

Other values, such as existence, option and bequest values, can and have been expressed in monetary terms in the economics literature. The economics literature clearly shows that people hold passive-use values for a variety of conditions on national forests. Although the Forest Service recognizes the validity and importance of these values, the existing literature is not sufficient to serve as a quantitative measure for some of the values since they are often geographically localized in nature. Therefore, passive use values for such things as wildlife habitat must be taken into consideration in a qualitative sense. Since such values are not expressed in monetary terms, they are not included in the economic efficiency analysis. In the section below, LBL has addressed the importance of passive-use values, and has weighed them within their management decisions, and they have been used in the determination of 'net public benefits'.

Alternatives X and Y will yield the greatest benefits to the local areas due to a higher cumulative PNV. Alternative Z, with the lowest PNV, differs from Alternative Y with the greatest PNV by less than 20 percent, primarily because Alternative Y has a heavier emphasis on recreation and wildlife than the other alternatives. Although some programs may change between alternatives, both the costs and benefits change at a proportional rate.

The NFMA regulations define net public benefits as: 'An expression used to signify the overall long-term value to the nation of all outputs and positive effects (benefits) less all associated inputs and negative effects (costs) whether they can be quantitatively valued or not. Net public benefits are measured by both quantitative and qualitative criteria, rather than a single measure or index [36 CFR 219.3].'

For those resources that can be reasonably valued using market data (e.g. timber, minerals, and range) and for those non-market resources that have Forest Service estimated values from research (recreation), we have presented values in the present net value calculations.

Use and Passive-Use Values

A value is something that contributes to one or more person's psychological well-being. Different forest management regimes produce different types of economic stimulations and services that lead to values. In the case of LBL, alternatives are focused on wise resource use and conservation. This management style puts emphasis on recreational opportunities, watershed protection, resource management, and providing future generations with enhanced opportunities and options to enjoy the resources wisely. There are various ways in which each alternative provides value--all of which can be characterized as either use value or passive-use value.

Use Values

Use values are obtained when someone gets enjoyment from some form of direct interaction with the resource. Use values can help provide benefits such as exercise, socialization, escape from physical and social pressures, self gratitude, privacy, spirituality, recreation use, economic development, and others. The above mentioned benefits are results of the sub-values noted in Table 3.4.7I.

Definitions of the use values discussed in the table and this section are:

Use Values/Benefits Definitions

Direct Use: Providing an enjoyment to a user or group from a direct interaction/participation with the resource or opportunity.

Community: A benefit received by the community from the use and existence of an area, place, experience, or resource.

Research: A benefit received in the scientific community from the use and existence of an area or resource.

Sub-Values Definitions

On-site Recreation: recreation opportunities provided on LBL; may be at developed sites or at dispersed non-developed locations throughout the area.

Human Development: increase in population and impacts.

Cultural Heritage: experiencing and learning about the cultural history and heritage of the land. Also includes, not forgetting the people who once lived here and keeping their culture and heritage alive.

On-site hunting: hunting opportunities and experiences at LBL.

On-site-Environmental Education: environmental education opportunities provided on LBL; may be facility or non-facility-based

Research: opportunities for the government or public to conduct research.

Education: opportunities for individuals or groups to use LBL to learn.

Management: types of management opportunities explored and demonstrated. e.g., Recreation Management and Resource Management.

Economic Development: providing economic support to the region and local economies.

Subsistence use: customary and traditional uses by residents of wild renewable resources for direct personal or family consumption as food, shelter, fuel, clothing, tools, or transportation; for the making and selling of handicraft articles out of non-edible by-products of fish and wildlife resources taken for personal or family consumption, for barter, or sharing for personal or family consumption; and for customary trade.

Non-Recreation jobs: jobs that are created by the existence of LBL that are not in the recreation field.

Retirement Income: income that is contributed to the local and regional economies by retirement income.

Recreation Jobs: jobs that are created in the recreation field by the existence of LBL.

Table 3.4.7I: - Use Values/Benefits

Direct Use	Community	Scientific
Sub-Values	**Sub-Values**	**Sub-Values**
On-site Recreation	Non-recreation jobs	Research
Human Development	Retirement income	Education
Cultural-Heritage	Recreation Jobs	Management
On-site hunting	Subsistence Use	
*On-site Environmental Education	*Economic Development	
*Economic Development		

Use values/benefits categories were drawn from Morton, Pete *Wilderness Society; The Economic Benefits of Wilderness.* * Were added since all use benefits of different user types were not represented. Some Values/Benefits of original table were deleted since they were not relative to LBL.

Passive-Use Values

Passive-use value can be defined as satisfaction achieved by simply knowing that a resource, action, place, or opportunity exists, and a benefit from the knowledge of continued existence. Passive-use values can be broken down into three categories represented in chart below.

Definitions of passive-use values in this above table and section are:

Passive-Use Values/Benefits Definitions:

Option Value: When a person derives satisfaction simply from knowing that a resource, place, action, or opportunity exists for future direct or indirect use.

Bequest Value: Value of conserving a resource, place, action, or opportunity.

Existence Value: When a person derives satisfaction simply from knowing that resource place, action, or opportunity will continue existence.

Sub-Values Definitions:

On-site Primitive Recreation Experiences: providing primitive recreational opportunities.

Passive Vegetation Management: promotes the reversion of open lands to forest and forest cover types and minimal forest management in Core Areas.

Ecological Diversity: actively manage our land and water resources to support and enhance wildlife and outdoor recreation.

Table 3.4.7J - Passive-Use Values/Benefits

Option Value	Bequest Value	Existence Value
Future direct, indirect, and off-site benefits ↓ **Sub-Values:** *On-site Primitive Recreation Experiences *Passive Vegetation Management *Ecological Diversity *On-site Recreation *On-site Environmental Education *On-site Hunting	Value of conserving/managing forest or natural areas for future generations ↓ **Sub-Values:** *Ecological Diversity *Passive Vegetation Management *On-site Recreation *On-site Primitive Recreation Experiences *Cultural Heritage *On-site Environmental Education	Benefits from knowledge of continued existence ↓ **Sub-Values:** *On-site Primitive Recreation Experiences *Passive Vegetation Management *Ecological Diversity *On-site Recreation *On-site Environmental Education *Cultural Heritage *On-site Hunting

Use values/benefits categories were drawn from Morton, Pete *Wilderness Society; The Economic Benefits of Wilderness.* (*) Added since all passive-use benefits were not represented in relation to LBL. Majority of values/benefits of table were deleted since they were not relative to LBL. Values in above table were designed to represent the diversity of the population and what they value.

Both use and passive-use values are important to the quality of life among specific users and other persons. Both have been addressed in each alternative that LBL evaluated. Keep in mind that a significant number of people relate passive-use values to the designation of natural areas or wilderness areas; however, passive-use values can also be contributed to people by providing/designating Rec/EE opportunities, and cultural heritage protection, just to mention a few.

Many groups view passive-use values differently. For example, a developed recreation user may get satisfaction knowing LBL provides a variety of recreation opportunities for them or their children to use in the future. People who want to enjoy primitive recreation experiences might get the same satisfaction from LBL designating areas such as the General Forest Core Areas.

Below is an analysis of use-values and passive-use values, and how each alternative may satisfy them. Values were assigned by utilizing the best data available to the Forest Service in the form of surveys, research, and professional experience. LBL's capacity to meet passive use values relating to primitive recreation experiences was based on roadless area studies conducted at LBL. These values are also based on each alternative's prescription areas. The Use and Passive-Use Value Analysis for all alternatives was based on an increase or decrease from present day management (Alternative W).

Increases and decreases shown under Direct Use Values/Benefits are influenced in the estimated visitation change that could take place under each alternative, and the type of recreation focus that each alternative provides. (Table 3.4.7K)

Scale:
- - Small Decrease
- Moderate Decrease
N No Change or Slight Increase/Decrease
+ Moderate Increase
++ Large Increase

Use-Value Anaysis

Table 3.4.7K - Direct Use Values/ Benefits

	W	X	Y	Z
On-Site Developed Recreation	N	++	+	-
On-site Dispersed Recreation	N	N	++	N
On-site Primitive Recreation Experiences	N	N	+	+
Human Development	N	N	N	N
Cultural Heritage	N	N	N	N
On-site hunting	N	+	+	-
On-Site Facility Based Environmental Education	N	++	N	N
On-site Non-Facility Based Environmental Education	N	N	++	+

Increases and decreases shown under Community Use Values/Benefits are influenced in the visitation change that could take place under each alternative and IMPLAN data for this area related to labor income and employment.

Table 3.4.7L - Community Use Values/Benefits

	W	X	Y	Z
Subsistence Use	N	N	N	N
Non-Recreation Jobs	N	N	+	N
Retirement Income	N	+	+	N
Recreation Jobs	N	N	++	-
Economic Development	N	+	++	-

The Scientific Use Values/Benefits increases and decreases were based on the type of vegetation management proposed for each alternative as well as the type of recreation management that would be needed for the recreation opportunities that may exist under each alternative.

Table 3.4.7M - Scientific Use Values/Benefits

	W	X	Y	Z
Research	N	+	+	+
Education	N	+	++	+
Management	N	+	++	N

The Option Values effects in Table 3.4.7N were based on current situations (Alternative W) and whether there would be an increase or decrease in a person's gratification related to that specific sub-value. For example, Alternatives X and Y would provide a person who receives a value/benefit from knowing that LBL provides an opportunity for on-site hunting with the greatest gratification, measured by hunting days and game species, numbers, health, and habitat. (This example could be used for both bequest and existence values just by applying their specific definition to the example.)

Passive-Value Analysis

Table 3.4.7N - Option Value

	W	X	Y	Z
Ecological Diversity	N	+	+	-
Passive Vegetation Management	N	N	N	+
On-site Developed Recreation	N	+ +	N	-
On-site Dispersed Recreation	N	N	+	+
Onsite Primitive Recreation Experiences	N	N	N	+
On-site Hunting	N	+	+	-
On-site Facility Based Environmental Education	N	+ +	+	N
On-site Non-Facility Based Environmental Education	N	N	++	+

A bequest value is a value gained from knowing that conserving/managing forests or natural areas, and providing recreational opportunities for future generations exist.

Table 3.4.7O - Bequest Value

	W	X	Y	Z
Ecological Diversity	N	+	+	-
Passive Vegetation Management	N	N	N	+
On-site Developed Recreation	N	++	+	-
On-site Dispersed Recreation	N	N	++	++
On-site Primitive Recreation Experiences	N	N	N	+
On-site Facility Based Environmental Education	N	++	+	N
On-site Non-Facility Based Environmental Education	N	N	++	+
Cultural Heritage	N	N	N	N

An existence value refers to benefits gained from knowledge of continued existence of natural areas and recreational opportunities.

Table 3.4.7P - Existence Value

	W	X	Y	Z
Ecological Diversity	N	+	+	-
Passive Vegetation Management	N	N	N	+
On-site Developed Recreation	N	++	+	-
On-site Dispersed Recreation	N	N	++	+
On-site Primitive Recreation Experiences	N	N	N	+
On-site Facility Based Environmental Education	N	++	+	N
On-site Non-Facility Based Environmental Education	N	N	++	+
Cultural Heritage	N	N	N	N
On-site Hunting	N	+	+	-

Overall values of use and passive-use values address the diversity and the specific population that would receive the benefits, and the 2 million visitors that LBL receives annually.

Qualitative values analysis indicates that alternatives X, Y and Z all show some positive benefits as compared to Alternative W. Due to the amount of emphasis placed on managed recreational and educational activities in alternatives X and Y, larger increases are anticipated as compared to Alternative Z.

Compared to Alternatives W, X and Y, more increases in value benefits for primitive and lesser managed experiences exist under Alternative Z. These increases are due to the emphasis on passive land uses and fewer developed recreational opportunities.

Additional research of both Use and Passive-Use Values as they relate to eastern forests needs to be conducted. The information provided by studies to date can only provide conclusions that are general in nature (Hagen, Swanser, Vincent, Well., 1995).

3.4.8 Tourism

LBL, along with Kentucky Lake and Lake Barkley functions as a cornerstone destination for the region's $600 million tourism industry. Commercial tourism activity, in the form of resorts, marinas, campgrounds, motels, restaurants, and entertainment, is concentrated in counties immediately adjacent to Kentucky Lake and Lake Barkley. The region includes additional attractions such as national wildlife refuges and parks, museums and historic sites, and state parks.

The presence of LBL within the region provides such an attraction, that a majority of the communities base their appearance and appeal around LBL. LBL is used as a major recreation attraction when local communities attend trade fairs to increase tourism within the area. Based on Kentucky Western Waterland's Summer Surveys 2003, 53.5 percent of all visitors come to Western Kentucky for the lake attractions and activities. LBL's draw in St. Louis, MO; Louisville, KY; Evansville, IN; Memphis and Nashville, TN; Chicago, IL; and other major urban areas within seven hours are increasing each year as shown by our POS system.

Local communities are utilizing LBL as a "backyard" to host activities to draw visitors and recruit new business to the area. Major events held on LBL include outdoor sporting and hunting events, off-road jamborees, dragboat competitions, horseback riding events and rodeos; and more localized events such as campers' fairs, arts and crafts festivals, cultural and heritage events, and special nature programs. Communities often cite LBL as a primary reason businesses choose to relocate in the area. Companies often consider the "quality of life" in an area as one of the main criteria when considering locations for expansion. LBL helps to provide a "quality of life" advantage for the region when leaders seek to bring in new businesses.

LBL focuses on providing a diverse mix of activities and experiences to encourage visitors to stay in the area longer. A proven factor in community economic development is that expenditure per capita increases as average length of stay increases. LBL strives to provide some conveniences to visitors while avoiding competitive impacts to gateway businesses.

An average user of public lands stays approximately 19 hours in one trip, however, an average LBL user stays an average of 41 hours, which results in higher tourism dollars spent in local communities. This is why basic, emergency-type product sales are offered to respond to visitor demand and avoid "early departures" due to inconvenient or remote basic services. Use of gateway motels, food services, gas stations, shopping, and other businesses are actively encouraged at all facilities.

3.4.9 Social Importance of Public Lands

Social Importance of Public Lands

As populations increase, the national need for conservation of public land will continue to grow. People need accessible and safe places to connect with the out of doors for multiple and individual reasons. Places for people to get in touch with nature are becoming more precious with each passing generation. Public lands provide that place where people may experience the rich traditions and relationships associated with heritage, wildlife, forest, and water.

By "caring for the land and serving the people," the nation's national forest and recreation areas provide extraordinary economic, scientific, recreational, and educational benefits to society.

Social Importance of LBL

LBL receives visits from all 50 states totaling approximately two million visits each year. Citizens come to LBL seeking quality recreation and educational experiences connected to heritage, wildlife, forest, and water.

For the surrounding communities, LBL contributes significantly to the quality of life by providing employment, recreation, and education opportunities. Local communities showcase LBL as a unique asset for recruiting new business and industry to the area. Educational communities, ranging from the elementary level to university masters level, utilize LBL as a discovery, study, and research laboratory.

3.4.10 Forest Products

LBL provides a small percentage of the total sawtimber and pulpwood in the area market. A decision was made by the Forest Service not to harvest timber off LBL during the transition years. The historic data from LBL under TVA tenure indicates that 5.16 million board-feet were for sale each year, plus an average 6,500 cords.

Table 3.4.10A Hardwood Timber Summary for LBL

Fiscal Year	Timber Volume (mmbf)	Pulpwood (cords)
1983	5.39	9,235
1984	7.70	11,447
1985	5.50	8,238
1986	8.01	9,411
1987	6.03	7,297
1988	6.67	7,496
1989	7.12	8,325
1990	6.44	6,546
1991	6.21	6,343
1992	6.11	6,180
1993	0	0
1994	0	0
1995	3.19	6,403
1996	4.38	6,287
1997	4.68	5,022
TOTAL	**77.43**	**98,230**

The annual capacity for sawmills in the 35-mile impact area is 346.2 million board-feet. Local Mill capacity is listed in a table in Appendix B.6. The historic average for LBL production is 5.16 million board-feet, or 1.5 percent of the local capacity. As demonstrated in the table above, LBL prepared no timber for sale in FY 93 or 94, and under US Forest Service administration, has sold no green timber since 2000. The relative insignificance of the annual supply from LBL to the local market has had negligible impact on the employment or income to the surrounding communities.

Base Sale Schedule for 5 Decades

All timber production from suitable lands on LBL result from activities intended to enhance habitats, promote healthy forest conditions, or for purposes of recreation, according to the LBL mission. Analysis of timber production for the five decade period covered in this analysis resulted from estimating the yields from treatments prescribed by LBL biologists as those needed to produce the desired wildlife habitat conditions under each alternative.

Table 3.4.10B summarizes the estimated timber outputs for the four alternatives. This level of output in the first decade equates to the allowable sale quantity for the alternatives.

Table 3.4.10B Base Timber Sale Schedule

	mcf/Decade				
Alternative	1	2	3	4	5
W	7,272	8,593	9,942	11,280	12,508
X	9,867	11,740	13,554	15,577	17,735
Y	9,867	11,740	13,554	15,577	17,735
Z	5,673	6,713	7,771	8,940	10,173

Note: 1 mcf (thousand cubic feet) = approximately 5 mbf (thousand board feet).

	Acres/Decades				
Alternative	1	2	3	4	5
W	20,726	20,726	20,726	20,726	20,726
X	22,184	23,175	23,175	23,675	25,000
Y	22,184	23,175	23,175	23,675	25,000
Z	12,334	12,751	12,751	13,001	13,676

Table 3.4.10B discloses that Alternatives X and Y would place more timber in the local market than the other alternatives, followed by Alternatives W and Z. It is expected the products from these timber volumes would primarily be purchased by local timber operators.

Forest Treatment Methods and Rotations

Silvicultural activities may be categorized according to the type of regeneration they drive or enhance. Beginning a new stand all at once is an important trait of the even-aged management system where methods such as clearcutting, shelterwood, and seedtree cuts are used. Beginning a new stand by gradually replacing trees cut or lost while maintaining mixed sizes of larger trees as the predominant cover is a common trait of the uneven-aged system. Methods used in uneven-aged management are individual tree and group selection, thus the term selection system is often applied. These two systems are the only silvicultural systems recognized in the regulations implementing the National Forest Management Act (1982 revision). In 1998, the Society of American Foresters adopted a third silvicultural system which primarily employs a modified shelterwood method common in even-aged management. The intent of this system is to maintain an overstory of larger trees for various resource concerns such as visuals, soils, economics, and site amelioration. As new seedlings and sprouts develop, these oversory trees are not removed, thus creating a two-aged (two-tiered) system. This two-tiered method will be used most often on the dryer sites to help open stands up for regeneration and promote desirable herbaceous species. At LBL, many of these two-tiered stands develop into structures with three or more canopy layers, even on dryer sites, thus gaining the favorable attributes of uneven-aged management. Many of these stands on dryer sites will not be managed for the favorable attributes of even-aged management - efficient sprout and advance regeneration management with more rapid site utilization. In practice, applying even-aged systems on upland oak-hickory sites often leads to fewer impacts to trees, soils, and watershed. On dryer upland sites, the modified shelterwood defined as an even-aged system in NFMA and a two-aged system by SAF, accomplishes many benefits of both the even-aged and uneven-aged systems with fewer disadvantages overall.

The rotation ages for major forest types at the Land Between the Lakes (LBL) were developed from estimates of senescence and longevity of oak species in Eastern deciduous forests. Culmination of mean annual increment (CMAI) for major types at LBL is based on the growth models projected for pines, xeric oak, dry to mesic oaks, and mesic (mesophytes). Since CMAI indicates the point of reduced growth inflection and not the growth plateau, rotation ages based on senescence will be longer. Harvesting before CMAI would likely result in shorter rotations that do not meet other management objectives. Any rotations less than the point of CMAI will be in response to specific wildlife or recreation needs, or severe stand damage such as in an insect and disease epidemic or where weather related.

The CMAI and rotation ages displayed by major vegetation groups are as follows:

CMAI Age (yrs)	Scheduled Rotation Age (yrs)	Vegetation Group
95	100	Pine
90	120	Xeric Oak
100	120	Other Oak
100	140	Mesophytic

Departure from Non-declining Even Flow:

The regulations state that each unit should not schedule harvesting of more timber in one decade than can be sustained throughout each decade of the planning horizon, without good reason. The description of this constraint on management is “non-declining even flow.”

Table 3.4.10B indicates that Alternatives W, X, Y and Z do not propose to harvest more timber in the first decade than following decades.

Long Term Sustained Yield (LTSY)

Table 3.4.10C. Long Term Sustained Yield

	Alternative			
	W	X	Y	Z
LTSY (mcf/Year)	2,155	1873	1819	1936

Note: 1 mcf (thousand cubic feet) = approximately 5 mbf (thousand board feet).

The model that calculated the values for the base timber sale schedule also calculated the long term sustained yield. LTSY is an estimate of the highest wood product yield that could be produced on a sustained basis each year from those lands being managed for timber production in a manner consistent with the area’s multiple-use objectives. The purpose and result of this analysis is to disclose that none of the alternatives propose harvesting more timber than the land is capable of growing.

3.4.11 Special Uses

Demands made on the national forest for special use permits for a variety of uses are growing each year. Each application for a permit is reviewed to determine if it is in the public interest and is allowed by law. No permits for occupancy of NFS lands can be issued unless authorized by a specific law. In 2003, LBL administered about 322 permits on LBL.

Table 3.4.11A- Type of Permits or Agreements in 2001

Forest Service Special Use Permits	
Recreation	
Disabled Hunter Access	28
Special Events	46
Special Event Services	22
Concessionaire	3
Seasonal Camping	171
Research and Training	34
Agriculture Cooperative Farming	7
Utility Corridor (buried cable)	1
Land Use	1
Agreements Under the Protection Act	
Utility Corridors	4
Communication	4
State Agency in Facility	2
Total Permits and Agreements	**323**

For communication sites and utility rights of way, LBL will continue with sites officially designated under the LBL Protection Act. If single use sites or temporary sites are needed for permanent uses, the sites will be designated by following the formal designation process.

Direct, Indirect, and Cumulative Effects

Land and road ROWs, or construction could affect various wildlife species during maintenance of these corridors or access routes. Habitat alteration would potentially occur. On the other hand, many wildlife species can utilize and benefit from the early succession habitat provided by the construction and subsequent vegetative cover for road banks or utility covers on the ROWs (See discussion in Section 3.2). Cleared ROWs can contrast in form, line, color, and texture compared with natural conditions and is not expected to change from existing condition. ROW management has effects on scenery, as discussed in Section 3.4.7.

As a general rule, special use authorizations are discouraged especially if the same benefits can be achieved from private land. Sometimes these benefits can only be obtained from Forest Service or federally managed land, such as recreation uses, communication sites, and research projects. Special use access requiring OHVs must be consistent with National Forest Service policy. Each request for a special use authorization will be screened and evaluated to determine if the direct and indirect impacts to LBL can be mitigated.

In most cases, special use authorizations would have a low impact on federal land, especially if proper mitigation is addressed in all site specific environmental considerations and permit operating plans.

Cumulatively, there would be no significant effects to Special Uses.

3.4.12 Environmental Justice

A specific consideration of equity and fairness in resource decision-making is encompassed with the concerns of environmental justice and civil rights. Executive Order 12898, Federal actions to Address Environmental Justice in Minority Populations and Low-Income Populations, stipulates "each Federal agency shall make achieving environmental justice part of its mission by identifying and addressing, as appropriate, disproportionately high and adverse human health or environmental effects of its programs, policies, and activities on minority populations and low-income populations." Principles for considering environmental justice are outlined in Environmental Justice Guidance under the National Environmental Policy Act (Council on Environmental Quality (CEQ), 1997. The Executive Order also contains emphasis on the potential effects of agency actions on subsistence consumption of fish, vegetation or wildlife. The Executive Order also requires agencies to work to ensure effective public participation and access to information.

To fulfill these principles, environmental justice was considered throughout the land management planning process in the following phases:

1. Scoping and Public Participation – Efforts were made by the Forest Service to reach as many people in the area as possible, through mailings, newsletters, newspaper articles, news releases, radio interviews, and contacts with federal, state, and local governments, non-profit organizations, civic organizations, and other type of organizations. Participation was sought in various locations and formats throughout the planning process. (See Appendix A on Public Involvement.)

2. Determining the Affected Environment – The Socio-Economic Environment and Effects section of Chapter 3 for the EIS presented information related to population growth,

minority populations, population density, income, unemployment and poverty, and economic diversity in the area affected directly by LBL management, and compared this information within a more regional context when appropriate. There were no segments of the population identified who depend on subsistence consumption of fish, wildlife, or vegetation within the planning area. No areas were identified that had significant minority populations. However, the unemployment rate in the area is below the national level average; the work available produces an average family income low enough to be a factor in determining LBL programs and fees. Because Stewart and Henry counties of Tennessee qualify and are designated as Historically Underutilized Business (HUB) zones, for the purpose of evaluating environmental justice, this area is recognized as a 'low-income' population.

3. Analysis and Effects - Chapter 3 of the EIS, the Recreation Affected Environment and Environmental Education Affected Environment portion of the land management planning process, discusses in more detail the estimated effects for each alternative if implemented. Management actions that have the greatest potential for impacting human health are those that may influence air quality and water quality; LBL does not possess any of these problems. So, there are no disproportionately adverse environmental or health effects to the low-income populations, based on programmatic decisions and land allocations within the Area Plan or EIS.

4. Alternatives – Although low-income populations are identified in Stewart and Henry Counties of Tennessee, the alternatives considered in this EIS contain no management activities planned where the effects on human health are considered significant. Therefore, there was no need to develop an alternative specifically driven by an environmental justice concern.

5. Record of Decision - The record of decision must address any disproportionately high and adverse human health or environmental effects on a low-income population, minority, population, or Indian tribe. Based on the effects analysis in earlier parts on this chapter, there were none.

6. Mitigation – Mitigation measures to avoid, mitigate, minimize, rectify, reduce or eliminate the impacts on affected populations should be identified in the EIS. There are no mitigation measures necessary to specifically address an environmental justice concern.

* Environmental Justice issues are typically found in connection with proposals having adverse environmental effects that may affect public health. Those kinds of effects are less likely in a forest plan decision because a plan revision does not normally include site-specific projects or effects.

Other Effects

LBL's alternatives may impact low income persons and families by charging fees at specified facilities. Alternatives W, X, and Y would produce the same impact; Z may reduce fees or eliminates some fees. Fees under each alternative will be evaluated for changes in each Alternative.

For all alternatives, general access to LBL will be available to everyone. The general forest and many day-use areas will be open to everyone as well. There are free days provided each year to some facilities at LBL, and the expansion of these opportunities is being considered under all the alternatives. Nature Watch Demonstration Areas, in Alternatives Y and Z, will create more self-guided opportunities for all visitors, regardless of income.

3.4.13 Incomplete or Unavailable Information

LBL has used the most current scientific information available and state-of-the-art analytical tools to evaluate management activities and to estimate their environmental effects.

However, gaps exist in our knowledge. The Council on Environmental Quality Regulations discuss the process for evaluating incomplete and unavailable information (40 CFR 1502.22 (a) and (b)).

Chapter 4

CONSULTATION AND COORDINATION

4.1 List of Preparers and Contributing Sources

Table 4.1A – List of Preparers

Name and Title	Credentials and Experience
Core Team	
Barbara Wysock Area Planner	MS, Environmental Engineering, University of Cincinnati BE, Chemical Engineering, Vanderbilt University Federal Employment: Forest Service and Environmental Protection Agency
Richard T. Lomax Environmental Education Specialist	BS, Recreation Resource Mgt., University of South Alabama Federal Employment: Tennessee Valley Authority and Forest Service
Elizabeth P. Raikes Biologist, Fisheries and Wildlife Management	BS, Fisheries & Wildlife Mgt., Lake Superior State College AAS, Recreation & Wildlife Mgt., Hocking Technical College Federal Employment: Forest Service
Darrius Truss Soils Scientist	BS, Environmental Sciences, Alabama A&M University Federal Employment: Forest Service
Philip L. Sammon Writer/Editor; Public Affairs Specialist	Certified Public Affairs Officer, Journalist, Broadcaster Defense Information School, Ft. Meade, MD Federal Employment: Department of Defense, Department of Veterans Affairs, and Forest Service
Susanne DeCenso Office Automation Clerk	Certified Paralegal; Certification, Managerial Accounting Civilian professional experience
Leadership Team	
William P. Lisowsky Area Supervisor	BS, Civil Engineering, North Carolina State University Licensed Professional Engineer Federal Employment: Forest Service
Judy Hallisey Environmental Stewardship Department Manager	BS, Forest Resources Management, MS Watershed Science and Affiliated Faculty, University of Idaho Federal Employment: Forest Service

Table 4.1A - Continued

Brian Beisel Customer Service Department Manager	BS, Forest Management, University of Wisconsin Federal Employment: Forest Service
Kathryn Harper Communications Services Department Manager	BA and MFA, Visual Arts Communication, Louisiana State University; BA, Communication Design, Northeast LA State University Federal Employment: Tennessee Valley Authority and Forest Service
Barry Haley Business Performance Manager	Business Major (+ equivalent of MBA) Federal Employment: Department of Defense and Forest Service
Duane Cameron Law Enforcement Supervisor	Federal Employment: Forest Service Law Enforcement and Investigation
Extended Team	
Steve Bloemer Wildlife Biologist	MS, Biology, Tennessee Technological University BA, Biology, Murray State University Federal Employment: Tennessee Valley Authority and Forest Service
Steve Hanna Forester	BS, Forest Science, MS, Forest Ecology, University of Illinois; Ph.D. in Forest Ecology and soils, Auburn University Federal Employment: Forest Service
Gary Hawkins Recreation Services Manager	BS, Forestry, University of Kentucky Federal Employment: Forest Service
Russell Hayes Facility Engineer	BS Mechanical Engineering, University of Kentucky Federal Employment: Department of Defense and Forest Service
Robert Wise Archeologist	MA, Anthropology, State University of New York BA, Anthropology, Southern Illinois University Federal Employment: Forest Service
Daphne Sewing Environmental Education Manager	MS, Wildland Recreation Management, University of Idaho BS, Secondary Education, Southeast Missouri State University Federal Employment: Forest Service
Jim McCoy, Wildlife Biologist; Fire Management Officer	BS, Wildlife Biology, Arkansas Technical University Federal Employment: Forest Service
Other Specialists	
James R. “Red” Anderson, Cherokee NF	Forest Planner
Paul Arndt, Forest Service Region 8	Regional Planner
Greg Barnes, LBL	Social Scientist
Kristy Barnes, LBL	Forestry Recreation Specialist Facility Manager, Piney Campground
Bruce Bayle, Forest Service Region 8	ARM Program Manager Biological and Physical Resource Unit

Table 4.1A - Continued

Jane Benson, LBL	GIS, Mapping Specialist
Sharon Byers, LBL	Executive Secretary
Deborah Caffin, Forest ServiceRegion 8	Wilderness and Trails
Avanell Clardy, LBL	Resource Assistant
Alan Clingenpeel, Ouachita NF	Hydrologist
John Donahue, Jefferson NF	Forester
Matthew J. Edwards, LBL	Forestry Technician Turkey Bay Off-Highway Vehicle Manager
Bill Hughes, Forest ServiceRegion 8	Landscape Architect
Mary Hughes-Frye, Forest Service Region 8	Developed Recreation
David Jones, LBL	GIS, Mapping Specialist
Sandy Jones, LBL	Office Automation Clerk
Glen Kinder, LBL	Procurement Clerk
Emily Loomis, LBL	Recreation Trainee
Dale Wine	Fire Suppression Specialist
Tim Mersmann, Forest ServiceRegion 8	Planning Biologist Biological and Physical Resource Unit
Randall Mitchell, LBL	Wranglers Campground Manager
Rick Morgan, Forest ServiceRegion 8	Planning, NEPA, Budget
Crystal Powell, LBL	Recreation Specialist Hillman Ferry Campground Manager
Scott Ray, LBL	Wildlife Technician
Clair Redmond, Forest ServiceRegion 8	Regional Economist
William Ryan, LBL	Recreation Specialist Turkey Bay Off-Highway Vehicle Manager
Darrin Samborski, LBL	Environmental Education Specialist
Paul Schaefer, LBL	NEPA Specialist
Denise Schmittou, LBL	Public Affairs Specialist
James B. Thweatt, LBL	Forestry Technician Assistant Manager, Wranglers Campground
Eric Twombly, Wallowa-Whitman NF	Forest Service Soil Scientist
Regina Weakley, LBL	Information Assistant
Donna Thompson, LBL	Financial Management Technician
Wanda Crump	Office Automation Assistant
Alan Whited, LBL	Wildlife Biologist
Bob Wilhelm, Forest Service Region 8	Regional Planner

4.2 Distribution List

Individuals

Individuals who provided a comment response on the Draft Area Plan were sent a CD copy of the final documents. Unless otherwise requested, one copy was provided for each form letter received. Anyone who requested a paper copy of the draft documents was sent a paper copy of the final documents. The remaining individuals on the *Focus on the Future* mailing list, as of November 1, 2004, were notified of the availability of the FEIS.

All organizations and agencies in the following list received a copy of the FEIS and final plan.

Associations, Businesses, Federal Agencies, State, City, and County Agencies and Organizations

Absentee-Shawnee Tribe of Oklahoma
Advisory Council on Historic Preservation
Austin Peay State University Library
Benton County Public Library
Big Sandy Library
Bureau of Land Management
Cadiz-Trigg County Tourist Commission
Calloway County Public Library
Calvert City Library Branch
Caroline Neilson, US House of Representatives
Cherokee Nation of Oklahoma
Chickasaw Nation
Clarksville/Montgomery County Economic Development Council
Eastern Band of Cherokee Indians
Eastern Shawnee Tribe of Oklahoma
Environmental Protection Agency
Federal Aviation Administration
Federal Energy Regulatory Commission
Federal Highway Administration
Federal Railroad Administration
General Services Administration
Hardin Branch Library
Houston County Library
Humphreys County Public Library

Interstate Commerce Commission
John L. Street Library
Kentucky Department of Fish & Wildlife Services
Kentucky Division of Forestry
Kentucky Heritage Council
Kentucky Resources Council Inc
Kentucky State Nature Preserves Commission
Lyon County Public Library
Marshall County Public Library
McCracken County Public Library
Murray State University Library
National Marine Fisheries Service
National Wild Turkey Federation
NOAA Ecology and Conservation Office
Office of Economic Opportunity
Ohio River Basins Commission
Paducah Community College Library
Region 8, Regional Administrator
Rural Development Administration
Shawnee Trail Conservancy
Shawnee Tribe of Oklahoma
Southern Appalachian Biodiversity Project
Stewart County Public Library
Tennessee Department of Agriculture
Tennessee Valley Authority
Tennessee Wildlife Resources Agency
Berlin Moore, Judge Executive, Trigg Co., KY
Bill Frist, US Senate
Bob Jackson, US Senate
Brian T. Moody, Mayor of Grand Rivers, KY
Chris Lasher, Judge Executive, Livingston Co., KY
Danny Orazine, Judge Executive, McCracken Co., KY
David Wallace, County Mayor, Stewart Co., TN
Douglas Wieland, County Mayor, Montgomery Co., TN
The Honorable Ed Whitfield, US House of Representatives
J. R. Gray, US House of Representatives
Gayle Griffith, Mayor of Paris, TN
Jim Bunning, US Senate

Jim Cooper, US House of Representatives
Joey Pendleton, Kentucky Senate
John May, Judge Executive, Crittenden Co., KY
John Tanner, US House of Representatives
John W. Adams, Kentucky State Representative
Lamar Alexander, US Senate
Larry Elkins, Judge Executive, Calloway Co. KY
Marsha Blackburn, US House of Representatives
Mike Cherry, Kentucky State Representative
Mike Haywood, US Senate
Mike Miller, Judge Executive, Marshall Co., KY
Mitch McConnell, US Senate
Richard Adams; Kentucky State Senate
Robert Buckingham, Kentucky State Representative
Sara Boyd, Judge Executive, Lyon Co., KY
Steve Tribble, Judge Executive, Christian Co. KY
Thomas Rushing, Mayor of Murray, KY
Tony Smith, Judge Executive, Graves Co., KY
Van Knight, Judge Executive, Caldwell Co., KY
TN Department of Tourist Development
Tourism Development Cabinet, State of Kentucky
US Air Force
US Army Engr. Div, South Atlantic, CESAD
US Coast Guard (USCG)
US Department of Commerce
US Department of Defense
US Department of Energy
US Department of the Interior
US Department of Transportation
US Navy
US Department of Housing & Urban Development
US Fish and Wildlife Service
USDA Forest Service, Region 8
USDA National Agricultural Library

Chapter 5

GLOSSARY, ACRONYMS AND LIST OF REFERENCES

5.1 Glossary

Term	Definition
Accessibility	The relative ease or difficulty of getting to or from someplace, especially the ability of a site, facility or opportunity to be utilized by persons of varying physical and mental abilities.
Accessible Facility:	A single or contiguous group of improvements, that exists to shelter or support Forest Service Programs that is in compliance with the highest standard of current Federal or Forest Service accessibility guidelines, at the time of construction.
Advanced Regeneration	New growth which appears spontaneously or is induced under existing stands
Aesthetics	How visual features are perceived in relation to the sense of beauty.
Age-class	An aggregation of trees that are essentially the same age. Age-class is often used synonymously with "size-class."
Agricultural land	Lands suitable for a sustained yield of food, fiber, or forage crops. (excluding wood). Examples include cropland, pasture, orchards, vineyards, nurseries, confined feeding areas, farmsteads, etc.
Alluvial site type	Pertains to and generally representative of the bank of a river, lake, or other body of water, wetness for a period of time. See Section 3.2 of the FEIS for a full description of this site type.
Alternative	In Area planning, a mix of resource outputs designed to achieve a desired management emphasis as expressed in goals and objectives, and in response to public issues or management concerns.
Annuals	Plants living and growing for only one year or growing season.
Archaeological sites	(see Historic sites).
Aspect	The cardinal (north, south, etc.) direction a slope faces.
Bankfull stage	The point at which flooding occurs on the floodplain.
Basal area	The area of the cross-section of a tree inclusive of bark at breast height (4.5 feet or 1.37 meters above the ground) most commonly expressed as square feet per acre or square meters per hectare. Used to measure the density of a stand of trees. For shrubs and herbs it is used to determine phytomass. Grasses, forbs, and shrubs usually measured at or less than 1 inch above soil level and may also be tallied through the use of basal area factor angle gauge.
BEIG	Built Environment Image Guide, is a guide for design of administrative and recreation buildings, landscape structures, site furnishings, wayside structures, and signs installed or operated by the Forest Service, its cooperators and permittees.
Best Management Practices	A practice, or combination of practices, that is determined to be the most effective, practical means of preventing or reducing non-point source pollution to a level compatible with maintaining water quality.
Biological assessment	A "biological evaluation" conducted for major federal construction or planning projects requiring an environmental impact statement, in accordance with legal requirements under Section 7 of the Endangered Species Act (16 U.S.C. 1536(C)). The purpose of the assessment and resulting document is to determine whether the proposed action is likely to affect an endangered, threatened, or proposed species.

Biological diversity — The diversity of life in all its forms (i. e., genetic, species, ecosystem) and all its levels of organization. Also termed biodiversity.

Biological evaluation — A documented Forest Service review of its programs or activities in sufficient detail to determine how an action or proposed action may affect any proposed, endangered, threatened, or sensitive species.

Birds of Conservation Concern — Breeding migratory and non-migratory birds of the United States and its territories that are of concern for proactive conservation actions and that without these actions, are likely to become candidates for listing under the Endangered Species Act of 1973. The primary legal authority for Birds of Conservation efforts is the Fish and Wildlife Conservation Act of 1980.

Board foot — An amount of wood equal to a piece 12-inch by 12-inch by one-inch.

Bottomland — The normal flood plain of a stream.

Bottomland hardwood — Extensive wooded area on low alluvial land next to a forest river containing various tree species with hard compact woods such as oak, cherry, maple, etc.

Browse — Palatable twigs, shoots, leaves, and buds of woody plants that animals feed on.

Canopy — The layer of vegetation comprised of the foliage of tree crowns in a forest.

Canopy cover — The percent of a fixed area covered by the crown of an individual plant species or delimited by the vertical projection of its outermost perimeter. Small openings in the crown are included. Used to express the relative importance of individual species within a vegetation community, or to express the canopy cover of woody species. Canopy cover may be used as a measure of land cover change or trend. Often used for wildlife habitat evaluations.

Canopy Gap — In forest ecology, a space occurring in the general forest crown cover caused by the fall or death of one or more trees forming the canopy/

Central hardwoods — Refers to the forests of the central United States.

Chert — A structureless form of silica, closely related to flint, which breaks into angular fragments.

Clearcut — The removal of a timber stand (all trees greater than one inch in diameter) in one harvest cut under the even-aged silvicultural system. The cut area is prepared for either natural or artificial regeneration. A "modified clearcut" leaves 10 to 20 square feet of basal area in trees standing following all cultural treatments. These trees serve as perch trees, dens, and provide hard mast for wildlife.

Codominant tree — Trees with crowns forming the general level of the canopy and receiving full light from above but comparatively little from the sides; usually with medium-sized crowns more or less crowded on the sides.

Community — An assemblage of plants, animals, bacteria, and fungi that live in an environment and interact with one another; forming a distinctive living system with its own composition, structure, environmental relations, development, and functions.

Conservation — The protection, preservation, management, or restoration of wildlife and of natural resources such as forests, soils, and water.

Constraint — A qualification of the minimum and maximum amount of an output or cost that could or should be produced or incurred in a given time period.

Controlled burning — (see Prescribed fire)

Coppice — A method of regenerating a stand in which all trees in the previous stand are harvested and the majority of regeneration is from stump sprouts or root suckers.

Cord — A unit of gross volume measurement for stacked roundwood based on external dimensions, generally a four-foot by four-foot by eight-foot stack (128 cubic feet).

Core Area — A designated section of the General Forest area where minimal management measures are applied. These areas were formerly labeled as Biosphere Reserve Core Areas in the Draft Plan and Draft EIS.

Cover	Any physical or biological features or arrangements of features that provide shelter from weather or concealment from predators.
Cubic foot	A unit of measure reflecting a piece of wood 12 inches long, 12 inches wide, and 12 inches thick.
Culmination of Mean Annual Increment	The age at which the average rate of annual tree growth stops increasing and begins to decline. Mean annual increment is expressed in cubic feet measure and is based upon expected growth, according to the management intensities and utilization standards assumed in accordance with 36CFR 219.16(a)(2)(i) and (ii). Culmination of mean annual increment includes regeneration harvest yields and any additional yields from planned intermediate harvests.
Cultural resources	The physical remains (artifacts, ruins, burial mounds, petroglyphs, etc.) and conceptual content or context (such as a setting for legendary, historic, or prehistoric events for native people) of an area which is useful in gaining knowledge about man's past. Cultural resources are non-renewable.
Cultural site	The physical location of a cultural resource.
Cutting cycle	The planned, recurring time period between successive harvests within a forest management compartment. This term is also used to describe the time period between successive harvests within a stand.
Danger tree	A tree within a developed site, or adjoining area, which may cause bodily harm to users because of breakage or uprooting.
Decadent	(See Old growth)
Deferred maintenance	Any routine maintenance (weekly, monthly, semi-annually, etc.) that is delayed for any reason.
Den trees	Trees that are alive and contain holes or hollows in the trunk or limbs large enough to shelter wildlife. They are used by many birds, mammals, and reptiles throughout the year for nesting, cover, and protection from the weather.
Dens	Those sites chosen by a given species of wildlife to sleep, rest, hibernate, and/or rear young.
Desired condition	An expression of resource goals that have been set for a unit of land. It is written as a narrative description of the landscape as it will appear when the goals have been achieved. The condition also includes a description of physical and biological processes, the environmental setting, and the human experience.
Desired Landscape Character	Appearance of the landscape character to be retained or created over time, recognizing that a landscape is a dynamic and constantly changing community of plants and animals. It includes the combination of landscape design attributes and opportunities, as well as biological opportunities and constraints.
Desired non-native species	A non-indigenous species to an area that has been approved to focus management due to their non-invasive and non-threatening characteristics to native species.
Developed Recreation	Recreation use or opportunities occurring at developed sites.
Developed recreation site	A discrete place containing a concentration of facilities and services used to provide recreation opportunities to the public and evidencing a significant investment in facilities and management under the direction of an administrative unit in the National Forest System.
Development Level	A term that refers to campgrounds, expressed as Development Level 1-5. Visitors in levels 1 and 2 campgrounds generally seek a relatively primitive experience with a minimum of facilities for comfort or convenience. Level 3 developments focus on tent campers and small RVs that do not contain a water closet or bathing facilities some electrical sites may be present. Water hydrants are centrally located to serve 3-5 sites, and flush toilets are typical. Traditionally, a moderate degree of accessibility is provided. Level 4 and 5 developments serve users with RVs of all types. Showers, flush toilets and other amenities are available; individual water, sewer and electrical hookups are commonly provided; service buildings are located within 200 to 300 feet of all sites.

Diameter at breast height (dbh)	Tree diameter (outside bark) at breast height (4.5 feet above the ground).
Dispersed Recreation	Recreation opportunities or use occurring away from developed sites, providing very little contact with FS or volunteer staff.
Diversity	The distribution and abundance of different plant and animal communities and species within the area covered by a land and resource management plan.
Dominant tree	Trees with crowns extending above the general level of the canopy and receiving full light from above and partly from the side; larger than the average trees in the stands, and with crowns well developed but possibly somewhat crowded on the sides.
Drawdowns	Manual manipulation of water levels.
Dry Mesic site types	A transitional site type, between mesic and dry site types. Dry-mesic site types are associated with mid and lower slopes less than 460 feet elevation. (See Section 3.2 of the FEIS for a full description of this site type.)
Dry site type	Representative of soils with conditions which are very limited or devoid of moisture. (See Section 3.2 of this FEIS for a full description of this site type.)
Early successional habitat	A vegetative condition typically characterized by low density to no tree canopy cover and an abundance of herbaceous and/or woody ground cover. This condition may include early-successional forest, maintained openings, pastures, balds, and open woodlands.
Ecological study area	An area designated by LBL as containing significant or unique interrelationships between biotic organisms and their abiotic environment.
Ecosystem	The interacting populations of plants, animals, and microorganisms occupying an area, including the physical environment.
Effects	These include: (a) direct effects caused by an action and occur at the same time and place; (b) indirect effects caused by an action and are later in time or farther removed in distance, but still reasonably foreseeable. Effects and impacts as used in this document are synonymous.
Endangered Species Act of 1973	An act that enables endangered and threatened species to be conserved. It provides a program for the conservation of such species and takes appropriate steps to achieve the purposes of the (relevant) treaties and conventions.
Environmental Impact Statement	A disclosure document revealing the environmental effects of a proposed action, which is required for major federal actions under Section 102 of the National Environmental Policy Act, and released to the public and other agencies for comment and review. A Final Environmental Impact Statement (FEIS) is the final version of the statement disclosing environmental effects required for major federal actions under Section 102 of the National Environmental Policy Act.
Ephemeral stream	A stream or dry wash that flows during, and for short periods following rain or snowmelt. Ephemeral streams have a functional channel with streambed and banks and are annually cleared of debris and litter.
Erosion	The wearing away of the land surface by the action of wind, water, or gravity.
European Settlement	This refers to non-American Indian settlement. European settlement began in 1790 for LBL.
Even-aged silvicultural management	A silvicultural system that results in the creation of stands in which trees of essentially the same age grow together. (A spread of 20 years is considered one age class.) Even-aged forests are characterized by a distribution of stands of varying ages (and therefore tree sizes) throughout the forest area. Clearcut, shelterwood, and seed-tree cutting methods produce even-aged stands.
Even-aged methods	Regeneration methods designed to maintain and regenerate a stand with a single age class.
Even-aged stand	A stand of trees containing a single age class in which the range of tree ages is usually less than 20 percent of rotation.

Facility	A single or contiguous group of improvements that exists to shelter or support Forest Service Programs. The term may be used in either a broad or narrow context; for example, a facility may be a lookout tower, leased office, work center, separate housing area, visitor center, recreation complex, utility system, or telecommunications site.
Facility-based Environmental Education	Portion of overall EE program which utilizes components of highly developed facilities to assist in presentation of educational programs, activities, and messages.
Feathering	A treatment used along the edges of openings in the forest canopy to reduce shadow contrasts by manipulating the density and size of vegetation.
Federally listed species	Animals or plants that have been formally added to federal lists of endangered or threatened wildlife or plants by the US Fish and Wildlife Service and/or the National Marine Fisheries Service. In legal terms, also includes species formally proposed for addition to these lists.
Filter strip	Strips of grass, trees, and/or shrubs planted between water and cropland, situated between a potential, pollutant-source area and a surface-water body that receives run off. Filter strips provide water-quality protection by reducing the amount of sediment, organic matter, and some nutrients and pesticides, in the run off at the edge of the field, and before the run off enters the surface-water body. They also provide localized erosion protection since the vegetation covers an area of soil that otherwise might have a high erosion potential.
Fire Condition Class	Based on coarse scale national data, classes measure general wildfire risk: Class One – Fire regimes are usually within historical ranges. Vegetation composition and structure are intact. The risk of losing key ecosystem components from the occurrence of fire is relatively low. Class Two – Fire regimes on these lands have been moderately altered from their historical range by increased or decreased fire frequency. A moderate risk of losing key ecosystem components has been identified. Class Three – Fire regimes on these lands have been significantly altered from their historical return interval. The risk of losing key ecosystem components from fire is high. Fire frequencies have departed from historical ranges by multiple return intervals. Vegetation composition, structure, and diversity have been significantly altered.
Floodplains	Lowland or relatively flat areas joining inland and coastal water including, at a minimum, that area subject to a one percent (100-year return period) or greater chance of flooding in any given year. Although floodplains and wetlands fall within the riparian area, they are defined here separately as described in the Forest Service Manual.
Food plots	Open lands planted in crops deemed beneficial to a variety of wildlife species for food and cover.
Forage	Food eaten by wild or domestic animals usually through browsing or grazing. (see Green forage)
Forb	Any herbaceous plant other than a grass or grass-like form species growing in its native habitat (e.g., field, prairie, or meadow).
Forest	An area managed for the production of timber and other forest products, or maintained under woody vegetation for indirect benefits as protection of a watershed, recreation, or wildlife habitat.
Forest cover type	A descriptive classification of forest land based on present occupancy of an area by tree species (also known as "forest type"). Examples: Oak-hickory. Forests in which upland oaks or hickory, singly or in combination, constitute a plurality of stocking. Oak-pine or mixed. Forests in which hardwoods (usually upland oaks) constitute a plurality of stocking but in which pines account for 25 to 50 percent of the stocking. (Common associates include gum, hickory, and yellow poplar).
Forest health	The perceived condition of a forest derived from concerns about factors as its age, structure, composition, function, vigor, presence of unusual levels of insects or disease, and resilience to disturbance.

Forest land Land area with a minimum size of one acre and 100 feet in width at least ten percent stocked with trees of any size. Minimum stocking is determined by either crown cover or basal area: (1) tree crowns occupy at least ten percent of the potential canopy area and/or; (2) there are at least 100 seedlings and saplings combined per acre.

Forest management The process of planning, organizing, and implementing actions within a forested area.

Forest type A category of forest defined by its vegetation (particularly its dominant composition) as based on a percentage cover of trees.

Game species Any species of wildlife or fish for which hunting/fishing seasons and/or bag/creel limits have been prescribed, and which are normally harvested by hunters, trappers, and fishermen under State or Federal laws, codes, and regulations.

Geographic Information System An information processing technology to input, store, manipulate, analyze, and display spatial resource data to support the decision-making processes of an organization. Generally, an electronic medium for processing map information, typically used with manual processes to affect specific decisions about land base and its resources.

Goals Lofty, desired, end-result conditions normally expressed in broad, general terms.

Grassland Areas on which vegetation is dominated by grasses, grass-like plants, forbs, and/or cryptogams (mosses, lichens, and ferns), provided these areas do not qualify as built-up land or cultivated cropland. Areas identified in the FEIS include currently existing maintained open land, ecological restoration areas, old fields, hayfields, and utility and road rights-of-way.

Green forage All non-woody plants (grasses, grass-like plants, and forbs) and portions of woody plants (browse) available to wildlife for food. Only a portion of a plant is available for forage if the plant is to remain healthy.

Ground-nesting A classification of birds that construct their nests on the ground.

Groundwater Water within the earth or geologic stratum that supplies wells and springs.

Group selection A method of harvest in an uneven-aged silvicultural system in which trees are removed in groups large enough to allow new trees to become established and remain free to grow in direct sunlight.

Gullyheads The narrow beginning of a gully.

Habitat The total environmental conditions on a unit of land as they relate to the distribution of food, cover, and water.

Habitat diversity The variety and variability of habitat types as well as their interrelationships on a given area and scale.

Hardwoods Angiosperms, usually broadleaf and deciduous. Soft hardwoods are soft-textured hardwoods such as box elder, red and silver maple, hackberry, sweetgum, yellow poplar, blackgum, sycamore, black cherry, and elm. Hard hardwoods are hard-textured hardwoods such as sugar maple, hickory, dogwood, persimmon, black locust, beech, ash, black walnut, and all commercial oaks.

Harvest (timber) Cutting and removal of trees from the forest.

Harvest intensity The relative volume of wood removed per acre.

Herbicide A chemical used for killing or controlling the growth of undesirable plants.

Heritage Sites/Assets Remnants of past cultures that remind us of the centuries-old relationship between people and the land (from National Heritage Strategy); property, plant or equipment that are unique for one or more of the following reasons: (1) historical or natural significance; (2) cultural, educational or artistic/aesthetic significance; or (3) significant architectural characteristics.

High-grading Harvesting to extract only the most valuable trees from a forest. No consideration is given to regeneration requirements of tree species or for future development of the trees or forest.

Historic Landscapes	Industrial, agricultural, pastoral or domestic landscapes that have evolved over many years from human alteration. They are commonly functional and often vernacular, and may not always be visually pleasing, often responding to specific functions or topography, not formally planned or designed. They may be informal to the degree that they appear to be natural occurrences, or the spatial organization of built and natural elements may be quite traditional or formal. They are identifiable and can be mapped, either as point-specific features or enclaves within a larger landscape, as entire landscapes themselves, or as a combination of both.
Historic period	The time period from A.D. 1700 to within the past 50 years.
Historic site	Cultural sites more than 50 years old.
Hydrologic Unit Code (HUC)	A unique number "consisting of two to eight digits based on the four levels of classification in the hydrologic unit system." The hydrologic unit system is a means of dividing the United States "into successively smaller hydrologic units which are classified into four levels: regions, sub-regions, accounting units, and cataloging units:
Improvement cuttings	Intermediate cuttings made in older stands (past the sapling stage) to regulate species composition and tree quality.
Indicator Species	One of six categories of Focal Species per NFMA; an organism whose characteristics are used as an index of attributes too difficult, inconvenient, or expensive to measure for other species environmental conditions of interest.
Infestation	The attack by macroscopic organisms in considerable concentration. Examples are infestations of tree crowns by budworm, timber by termites, soil or other substrates by nematodes or weeds.
INFRA	An integrated database for collection/storage/use of information about features, land units, facilities and utilities, accessibility and real property. For recreation management, INFRA holds information on operation and maintenance costs, recreation funding shortfalls, recreation use data, information on accessibility, and inventories of facilities. INFRA, as a trademarked software program, brings together Oracle, Arc Info, and Arc View GIS technology, and supplements recreation management systems.
Infrastructure	The basic facilities, services and installations needed for the functioning of LBL, such as roads, communications systems, water, power lines, and buildings.
Integrated pest management (IPM)	The comprehensive systems approach to achieving economical pest control in an environmentally acceptable manner. The individual components of integrated pest management in forestry include cultural, mechanical, manual, prescribed fire, biological, chemical, and regulatory means.
Intermediate cutting	Any removal of trees between the time of stand formation and regeneration harvest. The purpose is to control stand growth by adjusting stand density. These cuttings are made without effort directed at regeneration.
Intermediate tree	Trees shorter than those in the dominant or codominant classes but with crowns extending into the general level of the canopy, receiving little direct light from above and none from the sides; characterized by small crowns considerably crowded on the sides.
Intermittent stream	A stream that flows in a well defined channel during the wet seasons of the year but not the entire year.
Interpretation	Communication activities, messages, and programs designed to improve individuals understanding of natural and cultural resources.
Introduced species	Non-native or exotic species of plants and animals that have been introduced to an area either accidentally or knowingly.
Invertebrates	Animals lacking a backbone or spinal column.
Karst (topography)	The relief of an area underlain by limestone that dissolves in differing degrees, thus forming numerous depressions or small basins.
Landscape	An area composed of interacting ecosystems that are repeated because of geology, land form, soils, climate, biota, and human influences throughout the area. Landscapes are generally of a size, shape, and pattern that are determined by interacting ecosystems.

Landscape Character — Particular attributes, qualities, and traits of landscape that give it an image and make it identifiable or unique.

Legume — A pod, such as that of a pea or bean, that splits into two valves (parts) with the seeds attached to one edge of the valves. Generally referred to as a plant of the pea family.

Lime — A material containing carbonates, oxides and/or hydroxides of calcium and/or magnesium used to neutralize soil acidity.

Litter — The uppermost layer of organic debris on the ground under a vegetative cover type, composed of freshly fallen or slightly decomposed vegetable material from foliage with small amounts of bark fragments, twigs, flowers, fruits, etc.

Locally rare — Species for which representation in LBL is a concern. Development of a locally rare species list is at the discretion of LBL and may be completed in cooperation with the state and other federal agencies as well as other interested groups, organizations, or individuals.

Log deck/landing — The location where felled trees are brought to be cut into logs and loaded onto trucks.

Logging — The occupation of felling trees, cutting them into logs and transporting the logs to sawmills or to a place of sale.

Low thinning — An intermediate thinning in which trees are removed primarily from the lower crown classes. This simulates, but also accelerates, the natural elimination of these classes in stand development.

Maintenance level (roads) — The level of service provided by a specific road and the maintenance required for that road, consistent with road management objectives and maintenance criteria.

Level 5 – Roads that provide a high degree of user comfort and convenience. Normally they are two-lane, paved facilities or aggregate surfaces with dust abatement.

Level 4 – Roads that provide a moderate degree of user comfort and convenience at moderate speeds. Most are two-lane and aggregate surfaced. Some may be single lane, and some may have dust abatement.

Level 3 – Roads open and maintained for travel by a prudent driver in a standard passenger car. User comfort and convenience are not considered priorities. Typically low speed, single lane with turnouts and native or aggregate surfacing.

Level 2 – Roads open for use by high-clearance vehicles. May be closed on an intermittent basis. Passenger car traffic is discouraged. Traffic is minor administrative, permitted, or dispersed recreation. Non-traffic generated maintenance is minimal.

Level 1 – These roads are closed to motorized use for a period of one or more years. They may be suitable and used for non-motorized uses, with custodial maintenance.

Management Indicator Species — An animal or plant selected for use as a planning tool in accordance with 1982 NFMA regulations (36 CFR 219.19). These species are used to help set objectives, analyze effects of alternatives, and monitor plan implementation. They are chosen because their population changes are believed to indicate the effects of management on selected biological components.

Management unit — The smallest forest activity area in LBL on which records are kept.

Mast — Fruits, berries, or nuts. An important food source for many wildlife species. Hard mast includes fruit or nuts of oaks, beech, walnuts, and hickories. Soft mast includes fruits and berries of black gum, dogwood, viburnums, crataegus, grape, blackberries, and honeysuckle.

Mature stands — Stands of trees that have grown into the sawtimber class but have not yet begun to decline and die from natural processes.

Memorandum Of Understanding (MOU) — A formal agreement between any two organizations or agencies, wherein the two parties agree to specific actions or items that are mutually beneficial to both, and are in the best interest of the organizations, their members, employees or patrons, as well as the general public in the case of federal agencies.

Mesic site type — Moist site conditions with relatively productive soil types. See Section 3.2 of the FEIS for a full description of this site type.

Mesophytic plants — Plants that are adapted to growing conditions where water availability is intermediate. Often referred to as "moist-site plants".

Mid-story — Shrubs and small trees growing between the forest floor and the canopy. This includes suppressed, overtopped, and intermediate trees.

Migrant species — An animal that shifts from one habitat to another whether by chance, as a normal phase of a life cycle, or as part of a population's expansion.

Million board feet (mmbf) — A large-scale measurement equal to one-thousand-thousand board feet of unfinished cut wood. Commonly, 1,000 board feet is written as 1 mbf, and 1,000,000 board feet is written as 1 mmbf ("M" is Roman numeral for 1,000).

Mitigation — A strategy contained within an alternative which seeks to a) avoid an impact by not taking a certain action; b) minimize an impact by limiting the degree or magnitude of the action and its implementation; c) rectify an impact by repairing, rehabilitating, or restoring the affected environment; d) reduce or eliminate an impact over time by preservation and maintenance operations during the life of the action; or e) compensate for an impact by replacing or providing substitute resources or environments.

Monitoring — Techniques used to validate standards, determine visitor expectations, needs and preferences and to assess resource conditions.

Monitoring and Evaluation (also M&E) — The process of determining, on a sample basis, how well the objectives of forest plan management practices have been met and what effects those practices had on the land and environment.

Motorized Recreation — Recreation that takes place on or in a vehicle or device powered by a motor, engine or other non-living power source. This includes but is not limited to ATV's, motorbikes, aircraft, motor boats, motorized buggies and four wheel drive vehicles.

Multiple use — The management of all the various resources of the NFS so that they are used in a manner that will best meet the needs of the American people. Making the most judicious use of the land for these resources or related services over areas large enough to provide sufficient latitude for periodic adjustments in the use to conform to changing needs and conditions.

National Environmental Policy Act (NEPA) of 1969 — An act to declare a national policy that will encourage productive and enjoyable harmony between humankind and the environment.

It was created to promote efforts that will prevent or eliminate damage to the environment, biosphere, and stimulate the health and welfare of humanity. In addition, the Act was crafted to enrich the understanding of the ecological systems and natural resources important to the nation, and establish a Council of Environmental Quality.

National Forest Management Act (NFMA) of 1976 — Act passed as an amendment to the Forest and Rangeland Renewable Resources Planning Act, requiring the preparation of regional guides and forest plans, and the preparation of regulations to guide them.

National Recreation Trails — Trails designated by the Secretary of the Interior or the Secretary of Agriculture as part of the national system of trails authorized by the National Trails System Act. National recreation trails provide a variety of outdoor recreation uses in or reasonably accessible to urban areas.

National Register of Historic Places — The National Register of Historic Places is the nation's official list of cultural resources worthy of preservation. Authorized under the National Historic Preservation Act of 1966, the National Register is part of a national program to coordinate and support public and private efforts to identify, evaluate, and protect our historic and archeological resources. Properties listed in the Register include districts, sites, buildings, structures, and objects that are significant in American history, architecture, archeology, engineering, and culture. The National Register is administered by the National Park Service, which is part of the US Department of the Interior.

National Visitor Use Monitoring (NVUM)	A systematic process to estimate annual recreation and other uses of National Forest lands through user surveys.
National Wilderness Preservation System	All lands covered by the Wilderness Act and subsequent wilderness designations, irrespective of the department or agency having jurisdiction.
Native species	Species normally indigenous to an area; not introduced by man.
Natural regeneration	An age class created from natural seeding, sprouting, suckering, or layering.
Neotropical migratory Birds (NMB)	Birds that breed in the United States during summer and winter in Mexico, Central America, South America, and the Caribbean Basin.
Non-facility-based Environmental Education	Method of interpretation in which targeted educational messages are delivered in sites unassociated with the highly developed educational facilities. Interpretive signs, trails and printed materials are examples of these methods.
Non-game species	Any species of wildlife or fish which is ordinarily not managed or otherwise controlled by hunting, fishing, or trapping regulations. The designation may vary by state.
Non-native species	Any species of plant or animal that is not historically indigenous to a given area or locale.
Objectives	Concise statements of measurable, desired results intended to promote achievement of goals.
Off-Highway Vehicle (OHV)	Any vehicle capable of being operated off established roads (e.g., motorbikes, and small and large four-wheel drive vehicles).
Old growth	Ecosystems distinguished by old trees and related structural attributes. Old growth encompasses the latter stages of stand development. These latter stages typically differ from earlier successional stages in a variety of ways which may include tree size; accumulations of large, dead woody materials; number of canopy layers; species composition; and ecosystem function.
Open land	Land permanently maintained in a non-forested condition but not developed.
Optimum	The point at which the condition, degree, or amount of something is the most favorable. Biologically it is the most favorable condition for growth and reproduction.
Outposts	At LBL, these are small “camp stores” that provide basic necessities to visitors at the three highly-developed campgrounds.
Overstory	Trees forming the upper or uppermost canopy level in a forest of more than one story. Relative to even-aged stands; the mature trees which overtop the younger trees.
PAOT	Persons-at-one-time; a measure of recreation carrying capacity, especially for developed sites. National conventions include 5 persons per family picnic/camp unit, 3.5 persons per parking lot stall at a trailhead or visitor center, 1.5 persons per motorcycle parking stall and 40 persons per tour bus parking stall.
Partial cutting	(see Intermediate cutting).
Partnership	Voluntary, mutually beneficial and desired arrangement between the Forest Service and another or others to accomplish mutually agreed-on objectives consistent with the agency’s mission and serving the public’s interest.
Perennial stream	A stream that carries water during 90 percent or more of one year.
Perennials	Present in all seasons of the year.
Pest control	Actions taken to remove, eliminate or prevent infestation by undesirable (pest) species of plants or animals in a specific area.
Pheromone	Any hormonal substance secreted by an individual which stimulates a physiological or behavioral response from an individual of the same species.

Physiographic divisions/provinces	Systematic description of areas with some point of physical geology in common.
Poletimber	Live trees at least five inches in diameter at breast height (dbh) but smaller than sawtimber (11.0 inches dbh) size.
Prehistoric	The time period from AD 1000 to 1700.
Prescribed fire	The practice of using controlled fires to reduce or eliminate the unincorporated organic matter of the forest floor, or low, undesirable vegetation (often referred to as controlled burning).
Project	A work schedule prescribed for a project area to accomplish management prescriptions. An organized effort to achieve an objective identified by location, activities, outputs, effects, time period, and responsibilities for execution.
Proposed action	In terms of the National Environmental Policy Act, the project, activity, or decision that a federal agency intends to implement or undertake. The proposed action described in the Environmental Impact Statement is the Forest Plan.
Public roads	Roads across national forest land which were in place as public ways when these lands were acquired. These roads may be a part of the forest, state, or county system, and may be maintained by any of these agencies.
Q-factor	A geometric progression of increasing numbers of trees with decreasing diameters used for uneven-aged management.
Rare species	Any native or once-native species of plant or wild animal which exists in small numbers, and has been determined to be in need of special management consideration and monitioring.
Reconstruction	Work that includes, but is not limited to, widening of roads, improving alignment, providing additional turnouts, and improving sight distance that improve the standard to which the road was originally constructed. Also undertaken to increase the capacity of the road or to provide greater traffic safety.
Recreation Opportunity Spectrum (ROS)	Range of opportunities expressed in terms of three principal components: the activity, the setting and the experience. The combinations of these are arranged along a continuum called the Recreation Opportunity Spectrum (ROS) and divided into six classes: Primitive; Semi-Primitive non-motorized (SPNM); Semi-primitive motorized (SPM); Roaded Natural; Roaded; and Urban.
Recreation Visit	The entry of one person upon a National Forest to participate in recreation activities for an unspecified period of time. An NF visit can be composed of multiple site visits.
Reforestation	The natural or artificial restocking of an area with trees.
Regeneration	The process by which young trees replace older trees, removed by harvest or disaster.
Region 8	The states that make up the Southern Region of the USDA Forest Service.
Regional Forester	The official responsible for management of NFS land within a USDA Forest Service region.
Regional Forester's Sensitive (RFS) species	Species assigned to a list developed by the Regional Forester in coordination with the Forests in the Region. LBL is in Region 8. These species are those in need of special management to maintain viable populations.
Release cutting	An intermediate treatment conducted to regulate species composition and improve the quality of very young stands.
Research Natural Area	Special areas designated in LBL by TVA in cooperation with the American Forester's Society to allow for studying natural ecological processes.
Residual trees	Live trees left standing after completion of harvesting.

Revegetation	The re-establishment and development of a plant cover. This may take place naturally through the reproductive processes of the existing flora or artificially through the direct action of humans (e.g., afforestation and range reseeding).
Revision	To make the plan new or up-to-date. Plan revision must be considered and approved in accordance with the requirements for the development and approval of a forest plan. Revisions take place every 10-15 years, but may occur more frequently if conditions or public demands change significantly.
Riparian	Pertaining to the bank of a river, lake, or other body of water.
Riparian areas	Areas with three-dimensional ecotones of interaction that include terrestrial and aquatic ecosystems that extend down into the groundwater, up above the canopy, outward across the floodplain, up the near-slopes that drain to the water, laterally into the terrestrial ecosystem, and along the watercourse at a variable width.
Riparian Corridor	An administrative zone applied to both sides of a stream or along side a pond, lake, wetland, seep or spring. It is a fixed width by stream type that may fall within or beyond the true riparian area.
Road	A motor vehicle path more than 50 inches wide, unless classified and managed as a trail. It may be classed as a system or non-system road.
Road density	A measure of the total length of road in any given unit of area (e.g., four miles/square mile.)
Road maintenance levels	(See Maintenance Level.)
Road Management Objectives	Guiding criteria that establishes the intended purpose of a road based on management needs. These also contain operational and maintenance criteria for existing and potential future roads.
Roadless Area	Undeveloped federal land where there are no improved roads or roads maintained for travel by means of motorized vehicles intended for highway use.
Rotation	The period of time to establish, grow, and harvest a crop of trees to a specified condition of maturity.
Salvage cutting	Removal of trees that are dead, damaged, or imminently threatened with, death or damage in order to utilize the wood before it is rendered valueless by natural decay agents.
Sapling	Live trees one to five inches dbh.
Sawtimber	Softwoods nine inches dbh and larger, and hardwoods 11.0 inches dbh and larger.
Sawtimber volume	Growing-stock volume in the saw-log portion of sawtimber-sized trees, measured in board feet per acre (International 1/4-inch Log Rule).
Scalloping	The undulating vegetative edge treatment given to a travel way or opening for aesthetic purposes.
Scenery	General appearance of a place, general appearance of a landscape, or features of a landscape.
Scenery Management System	A system for the inventory and analysis of the aesthetic values of the National Forest Lands. It replaces the Visual Management System (VMS) as defined in Agriculture Handbook #462.
Scenic Class	A system of classification describing the importance or value of a particular landscape or portions of that landscape. Values range from 1 (highest value) to 7 (lowest value).
Scenic Integrity	A measure of the degree to which a landscape is visually perceived to be "complete." The highest scenic integrity ratings are given to those landscapes which have little or no deviation from the character valued for its aesthetic appeal. Scenic integrity is used to describe an existing situation, standard for management, or desired future conditions.

Scenic Integrity Objective (SIO) A desired level of excellence based on physical and sociological characteristics of an area. Refers to the degree of alterations to the valued attributes of the characteristics of an area. Objectives include:

Very High (VH) – Generally provides for only ecological changes in natural landscapes and complete intactness of landscape character in cultural landscapes

High (H) – Human activities are not visually evident to the casual observer. Activities may only repeat attributes of the form, line, color and texture found in the existing landscape character.

Moderate (M) – Landscapes appear slightly altered. Noticeable human-created deviations must remain visually subordinate to the landscape character being viewed.

Low (L) – landscapes appear moderately altered. Human created deviations begin to dominate the valued landscape character being viewed but borrow from valued attributes such as size, shape, edge effect and pattern of natural openings, vegetative type changes, or architectural styles outside the landscape being viewed.

Scoping The process by which a federal agency identifies important issues and determines the extent of analysis necessary for an informed decision on a proposed action. Scoping is required by NEPA, and is an integral part of environmental analysis.

Scoured channel A definable channel of flow where surface water converges with enough energy to remove soil, organic matter, and leaf litter.

Sediment Solid mineral and organic material that is in suspension, is being transported, or has been moved from its site of origin by air, water, gravity, or ice.

Sedimentation The action or process of depositing sediment.

Seed tree An even-aged regeneration method where in a single cut, the removal of all merchantable trees in a stand, except for a small number of widely dispersed trees retained for seed production; to produce a new age class in a fully-exposed microenvironment.

Seedling Live trees of commercial species less than one inch dbh that are expected to survive and develop.

Seep A wet area where a seasonal high water table intersects with the ground surface. Seeps that meet the definition of a wetland are included in the Riparian Corridor.

Selection cutting The removal of selected trees, particularly mature trees at planned intervals (cutting cycle), individually or in small groups, from an uneven-aged forest to realize the yield, and establish a new crop of desired tree species. Additionally, the tending of immature stand components is accomplished at each cutting cycle.

Sensitive species Species that are listed with states as needing special management.

Shade-intolerant A tree or other plant species which requires direct sunlight for optimum growth.

Shade-tolerant A tree or other plant species having the capacity to grow without receiving direct sunlight.

Shelterwood A regeneration method of regenerating an even-aged stand in which a new age class develops beneath the partially shaped microenvironment provided by the residual trees. The sequence of treatments can include three distinct types of cuttings: (1) an optional preparatory harvest to enhance conditions for seed production; (2) an establishment harvest to prepare the seed bed, and to create a new age class; and (3) a removal harvest to release established regeneration from competition with the over-wood.

Shelterwood method An even-aged harvesting method which removes mature timber in a series of cuttings which extend over a relatively short portion of the rotation in order to encourage establishment of essentially even-aged reproduction under partial shelter of seed trees.

Shrub A woody perennial plant smaller than a tree, usually having permanent stems originating from or near the ground.

Sidewalls The lower, widening upslopes of a gully, leading away from the gully head and downstream or downhill.

Silviculture	The art and science of controlling the establishment, growth, composition, health, and quality of forests and woodlands. Silviculture entails the manipulation of forest and woodland vegetation in stands and on landscapes to meet the diverse needs and values of landowners and society on a sustainable basis.
Single-tree selection	A selection system in which trees are individually removed and openings are created through successive cuttings.
Site	The situation of a growing plant with respect to all environmental factors (as climate, soil, drainage, other plant and animal life) affecting growth.
Site Visit	(See Recreation Visit.)
Slope	Degree of deviation of a surface from the horizontal, measured as a numerical ratio, percent, or in degrees. Expressed as a ratio, the first number is the horizontal distance (run) and the second is the vertical distance (rise), as two:one. A two:one slope is a 50 percent slope. Expressed in degrees, the slope is the angle from the horizontal plane, with a 90 degree slope being vertical (maximum) and 45 degree being a one:one slope.
SMS	Scenery Management System, a system for the inventory and analysis of the aesthetic values of the National Forest Lands. The SMS replaces the Visual Management System (VMS) as defined in Agricultural Handbook #462.
Snag	A standing dead tree. These trees have little or no commercial value. While decaying, they provide important perching, feeding, nesting, and roosting habitat for numerous wildlife species.
Softwoods	Gymnosperms, in the order Coniferales, usually evergreen, having needles or scalelike leaves (pines).
Soil productivity	The inherent capacity of a soil to support the growth of specified plants, plant communities, or a sequence of plant communities. Soil productivity may be expressed in terms of volume or weight/unit area/year, percent plant cover, or other measures of biomass accumulation.
Soil survey	A term for the systematic examination of soils in the field and in laboratories; their description and classification; the mapping of kinds of soil; the interpretation of soils according to their adaptability for various crops, grasses, and trees; their behavior under use of treatment for plant production or for other purposes; and their productivity under different management systems.
Soils, fine-textured	Consisting of or containing large quantities of the fine fractions, particularly of silt and clay (includes clay loam, silty clay loam, sandy clay, silty clay, and clay textural classes).
Special-use permit	A permit issued to an individual, organization, or company for occupancy or use of NFS land for some special purpose.
Species	A class of individuals having common attributes and designated by a common name.
Species of viability concern	These include federally-listed, Regional Forester's Sensitive, Birds of Conservation Concern, and locally rare species and communities.
Spring	A water source located where water begins to flow from the ground due to the intersection of the water table with the ground surface. Generally flows throughout the year. Springs that are the source of perennial or intermittent streams are included in the riparian corridor.
Stand	An aggregation of trees occupying a specific area and sufficiently uniform in composition, age arrangement, and condition to be distinguishable from the adjoining forest. Also referred to as "Timber stand".
Stand density	A quantitative measure of stocking expressed either absolutely per unit of land in terms of number of trees, basal area, volume per unit area, or relative to some standard condition.
Standard	Requirement that precludes or imposes limitations on resource management practices and uses. Usually for resource protection, public safety, or addressing an issue.
State listed species	Listed species formally added to state lists by appropriate state agencies. May or may not be federally listed or a Regional Forester's Sensitive species.

State Natural Area	An area that represents intact ecosystems and serves as reference areas for how natural ecological processes function. These areas are managed through Cooperative Management Agreements with state agencies.
Stocking	An indication of the number of trees in a stand as compared to the desirable number for best growth and management. Often expressed in percent.
Stream drainage basins	Watershed that collects and discharges surface stream flow through one outlet or mouth.
Streamside	An area of 50 feet or more on both sides of bodies of open water, perennial streams, and some intermittent and ephemeral streams where extra precaution is used in carrying out forest or open land management practices in order to protect bank edges, water quality, and wildlife habitat.
Succession	An orderly process of biotic community development that involves changes in species, structure and community processes over time; it is reasonably directional and, therefore, predictable.
Suitability	The appropriateness of applying certain resource management practices to a particular area of land, as determined by an analysis of the economic and environmental consequences and the alternative uses foregone. A unit of land may be suitable for a variety of individual or combined management practices.
Suppressed tree	(See Overtopped tree.)
Sustainable	To keep in existence; maintain.
Thinning	An intermediate treatment or harvest designed to reduce stand density and remove some merchantable timber.
Thousand cubic feet	A measurement of unfinished cut wood equal to approximately 5000 board feet. This measurement is becoming more commonly used among commercial timber companies, and is being adopted by the Forest Service units to make equivalent comparisons with commercial users in estimating timber harvests for proposed projects.
Threatened species	Any species that is likely to become an endangered species within the foreseeable future throughout all or a significant portion of its range. Designated as a threatened species in the *Federal Register* by the Secretary of Interior.
Timber Stand Improvement (TSI)	Usually related to activities conducted in young stands of timber to improve growth rate and form of the remaining trees. Examples are thinning, pruning, fertilization, and control of undesirable vegetation.
Topography	The physical features of a place or region. Commonly refers to land forms and variation in elevation.
Trailheads	The parking, signage, and other facilities available at the terminus of a trail.
Two-aged stand	A stand composed of two distinct age classes that are separated in age by more than 20 percent of rotation.
Understory	The lowermost strata of shrubs and herbaceous vegetation beneath the forest canopy.
Uneven-aged silviculture management	A silvicultural system designed to maintain a forest or stand composed of trees that are markedly different in age. Cutting methods used are single-tree and group selection.
Upland	Land at higher elevation, in general, than the alluvial plain or stream terrace; land above the lowlands along streams.
Vegetative filter strips	(See Filter Strip.)
Viable population	Population of plants or animals that has the estimated numbers and distribution of reproductive individuals to ensure its continued existence is well distributed in the planning area.
Vistas	A confined view, especially one seen through a long passage, as between a row of trees. A vista is often toward, or focuses upon, a specific feature in the landscape. Unlike a view, the vista is often man-created and, thereby subject to design.

Visual quality zones (VQZ)	Areas of the landscape denoted by specified distances from the observer. Used as a frame of reference in which to discuss landscape characteristics or activities of man sometimes referred to as "distance zones."
Watershed	The entire area that contributes to a drainage or stream.
Watershed Condition Classes	Class I- Watersheds exhibit high geomorphic, hydrologic, and biotic integrity relative to their natural potential condition. The drainage network is generally stable. Physical, chemical, and biologic conditions suggest that soil, aquatic, and riparian systems are predominantly functional in terms of supporting beneficial uses. Class II- Watersheds exhibit moderate geomorphic, hydrologic, and biotic integrity relative to their natural potential condition. Portions of the watershed may exhibit an unstable drainage network. Physical, chemical, and biologic conditions suggest that soil, aquatic, and riparian systems are at risk in being able to support beneficial uses. Class III- Watersheds exhibit low geomorphic, hydrologic, and biotic integrity relative to their natural potential condition. The majority of the drainage network may be unstable. Physical, chemical, and biologic conditions suggest that soil, aquatic, and riparian systems do not support beneficial uses.
Wetland	Geographic areas characteristically supporting hydrophytes, hydric (wet) soils, and some saturation or flooding during the growing season.
Wilderness	A Congressionally-designated area that is part of the National Wilderness Preservation System established through the Wilderness Act of 1964; also defined in the Act as a wilderness, in contrast with those areas where man and his own works dominate the landscape, is hereby recognized as an area where the earth and its community of life are untrammeled by man, where man himself is a visitor who does not remain. An area of wilderness is further defined to mean in this chapter an area of undeveloped federal land retaining its primeval character and influence, without permanent improvements or human habitation, which is protected and managed so as to preserve its natural conditions and which (1) generally appears to have been affected primarily by the forces of nature, with the imprint of man's work substantially unnoticeable; (2) has outstanding opportunities for solitude or a primitive and unconfined type of recreation; (3) has at least five thousand acres of land or is of sufficient size as to make practicable its preservation and use in an unimpaired condition; and (4) may also contain ecological, geological, or other features of scientific, educational, scenic, or historical value.
Wilderness Study Area (WSA)	Lands possessing the basic characteristics of wilderness and designated by Congress for further wilderness study.
Wildfires	Uncontrolled fires occurring in forest land, brushland, and grassland.
Wildlife	All non-domesticated mammals, birds, reptiles, and amphibians living in a natural environment, including game species and non-game species. Animals, or their progeny (i.e., feral animals - including horses, burros, and hogs), that once were domesticated, but escaped captivity, are not considered wildlife.
Wildlife cut	In LBL, a timber cutting practice resulting in early successional forest habitat.
Wildlife waterhole	Ponds and creek dams one-tenth acre or less in size, and three to four feet deep. Constructed at about one-half mile intervals to supply adequate year-round water for wildlife.
Wildlife woods openings	An administratively designated development that is constructed and maintained to improve wildlife habitat. Areas designated as managed wildlife openings may include cereal grain plantings, warm-season grass plantings, legume plantings, old-fields successional lands, or native herbaceous open lands.
Woodland	A plant community in which trees are often small, characteristically with a greater proportion of their total height being crown more so than clear bole, and having trees spaced far enough apart that the canopies of adjacent trees usually do not touch and with the ground vegetation being mostly herbaceous, commonly grass.
Work area	Forest land management unit on LBL ranging in size from 1,025 to 4,000 acres and generally defined by physical boundaries such as roads, streams, trails, etc. Work areas generally contain a mix of all forest types and land uses.

Xeric site type	Representative of extremely dry soil conditions and relatively poor soils. See Section 3.2 of the FEIS for a full description of this site type.
Young-growth	Live trees between the ages of one and 15 years

5.2 Acronyms

Acronym	Explanation
AI	Appreciative Inquiry
AQRV	Air Quality Related Values
BA	Biological Assessment
BCC	Birds of Conservation Concern
BE	Biological Evaluation
BMP	Best Management Practice
BOC	Budget Object Code
CEQ	Council of Environmental Quality
CFI	Continuous forest Inventory
CFR	Code of the Federal Regulations
CWA	Clean Water Act
dbh	diameter at breast height
DEIS	Draft Environmental Impact Statement
DOI	Department of the Interior
EA	Environmental Assessment
EBP	Elk & Bison Prairie
EE	Environmental Education
EIS	Environmental Impact Statement
EPA	Environmental Protection Agency
ESA	Ecological Study Area (also commonly used for 'endangered species act')
ETM+	Enhanced Thematic Mapper Plus
FEIS	Final Environmental Impact Statement
FLMP	Forest Land Management Practice
GAP	Gap Analysis Program
GIS	Geographic Information System
GPVC	Golden Pond Visitors Center
HP	The Homeplace
HQ	Hazard Quotient; in relation to pesticide and herbicide safety
HRMP	Heritage Resources Management Plan
IDT	Interdisciplinary Team
IPM	Integrated Pest Management
KLMP	Kentucky Lake Monitoring Program
LBL	Land Between The Lakes
LRMP	Land and Resources Management Plan
LT	Leadership Team
mcf	thousand cubic feet
M&E	Monitoring and Evaluation
MARC	Mid-America Remote Sensing Center

MGD	Million Gallons per Day
MIS	Management Indicator Species
MIST	Minimum Impact Suppression Tactics
mmbf	million board feet
MOS	Margin of Safety
MSA	Metropolitan Statistical Areas
NAAQS	National Ambient Air Quality Standards
NADP	National Acid Deposit Program
NEI	National Emissions Inventory
NEPA	National Environmental Policy Act of 1970
NFMA	National Forest Management Act
NO_3	Nitrates
NOAA	National Oceanographic and Atmospheric Administration
NOI	Notice of Intent
NO_x	Nitrogen Oxide
NPB	Net Public Benefit
NPDES	National Pollution Discharge Elimination System
NRA	National Recreation Area
NRCS	Natural Resources Conservation Service
NRMP	Natural Resources Management Plan
NS	Nature Station; also Woodlands Nature Station
O_3	Ozone
OHV	Off-Highway Vehicle
PAOT	Persons at one time
PBD	Planning Background Document
PCR	Primary Contact Recreation
PETS	Proposed, Endangered, Threatened and Sensitive
PILT	Payment In Lieu of Taxes
$PM_{2.5}$	Particulate Matter (2.5 micrometers in size)
PPM	Parts Per Million
RFS	Regional Forester Species
RMO	Road Management Objective
RNA	Research Natural Area
ROD	Record of Decision
ROS	Recreation Opportunity Spectrum
RVD	Recreation Visitor Day
RV	Recreational Vehicle
SBR	South Bison Range
SCR	Secondary Contact Recreation
SIC	Standard Industrial Code
SIP	State Implementation Plan

SMZ	Stream Management Zone
SNA	State Natural Area
SO_2	Sulfur Dioxide
SO_4	Sulfates
SWCP	Soils and Water Conservation Practices
TSI	Timber Stand Improvement
TVA	Tennessee Valley Authority
USACE	US Army Corps of Engineers
USDA	United States Department of Agriculture
USFWS	US Fish & Wildlife Service
VQZ	Visual Quality Zone
WAH	Water Aquatic Habitat
WIN	Watershed Improvement Needs
WMA	Wildlife Management Area
WR	Wildlife Refuge
WSA	Wilderness Study Area

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5.4 Index

G

H

I

L

M

N

O

P

Q

R

S

T

U

V

W

Y