United States
Department of
Agriculture

Forest Service
Southern Region

Final Environmental Impact Statement

FOR THE

Revised Land and Resource Management Plan

Jefferson National Forest

Management Bulletin R8-MB 115B **January 2004**

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ABSTRACT

This Environmental Impact Statement describes seven alternatives and their environmental consequences for revising the Land and Resource Management Plan (Forest Plan) for the Jefferson National Forest. It includes a "no action" alternative which would continue managing the land and resources of the Jefferson National Forest under the 1985 Forest Plan as amended. Alternative revised management direction is developed for all 723,300 acres of National Forest System ownership on the Jefferson National Forest. Although the George Washington National Forest and Jefferson National Forest have been administratively combined, they continue to have separate Forest Plans. Alternatives have been coordinated with that of the George Washington National Forest, Cherokee National Forest in Tennessee, Chattahoochee-Oconee National Forest in Georgia, National Forests in Alabama, and the Sumter National Forest in South Carolina. The alternatives provide different mixes of goods and services through various goals, objectives, management prescriptions, and standards.

Final Environmental Impact Statement

FOR THE

Revised Land and Resource Management Plan

Jefferson National Forest

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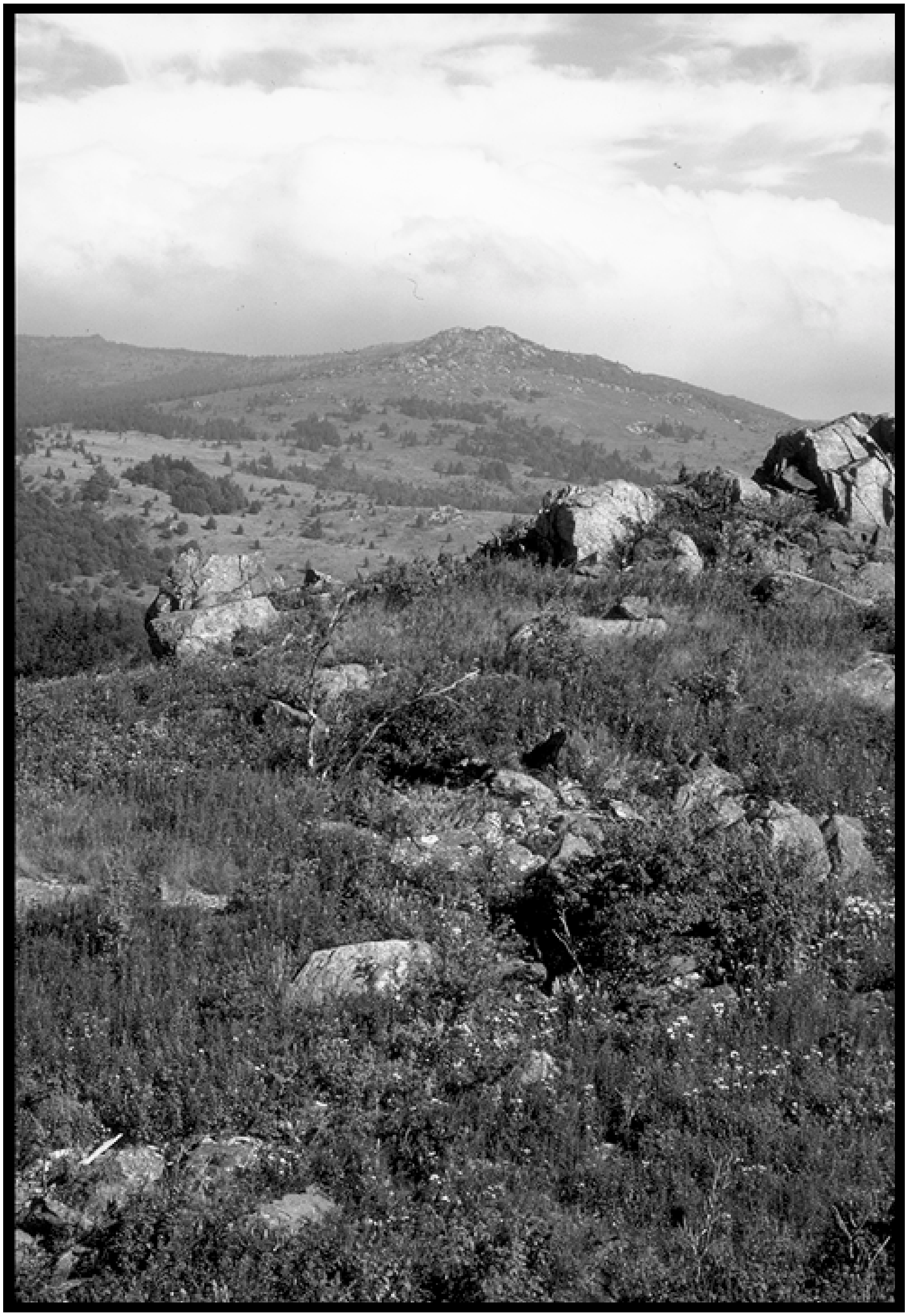

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PURPOSE AND NEED

CHAPTER 1

INTRODUCTION

FOREST PLAN DECISIONS

INTRODUCTION

The purpose of this proposed action is to revise the Jefferson Land and Resource Management Plan (Forest Plan). The revised Forest Plan guides all natural resource management activities on the Jefferson National Forest to meet the objective of Federal law, regulations, and policy. The proposed action also affects a wide range of socioeconomic factors, as they relate to natural resources. The existing Forest Plan for the Jefferson National Forest was approved October 16, 1985. As of November 1, 2003, there were ten amendments to the existing Forest Plan. Revision of the Forest Plan is now needed to satisfy regulation requirements and to address new information about the forest and its uses.

The George Washington and Jefferson National Forests were administratively combined in 1995. However, each National Forest continues to have its own Forest Plan. This Forest Plan only covers the Jefferson National Forest.

The regulations implementing the National Forest Management Act (NFMA) instruct the Regional Forester to make periodic revisions to forest plans and to provide the basis for any revision. The following section describes the need to change the 1985 Forest Plan and presents the basis for the proposed changes within the context of the regulatory requirements. The instructions to revise forest plans, the basis for revision, are found in Code of Federal Regulations 36 CFR 219.10(g).

This Final Environmental Impact Statement (FEIS) describes the analysis of several alternatives for revising the Forest Plan for the Jefferson National Forest and discloses the environmental effects of these alternatives. The FEIS is guided by the implementing regulations of the National Environmental Policy Act (NEPA) found in the Council of Environmental Quality Regulations, Title 40, CFR, Part 1500. The companion documents to this FEIS are the Forest Plan - a detailed presentation of the preferred alternative and the Record of Decision (ROD) - the justification for selecting the preferred alternative.

FOREST PLAN DECISIONS

National Forest System resource allocation and management decisions are made in two stages. The first stage is the Forest Plan, which allocates lands and resources to various uses or conditions by establishing management areas and management prescriptions for the land and resources within the plan area. The second stage is approval of project decisions.

Forest plans do not compel the agency to undertake any site-specific projects; rather, they establish overall goals and objectives (or desired resource conditions) that the individual national forest will strive to meet. Forest plans also establish limitations on what actions may be authorized, and what conditions must be met, during project decision making.

FOREST PLAN DECISIONS

SUPPORTING EISS

FOREST PROFILE

The primary decisions made in a Forest Plan include:

- Establishment of the forest-wide multiple-use goals and objectives [36 CFR 219.11(b)].
- Establishment of forest-wide management requirements [36 CFR 219.13 to 219.27].
- Establishment of multiple-use prescriptions and associated standards and guidelines for each management area [36 CFR 219.11(c)].
- Determination of land that is not suitable for the production of timber [16 USC 1604(k) and 36 CFR 219.14].
- Establishment of allowable sale quantity for timber within a time frame specified in the plan [16 USC 1611 and 36 CFR 219.16].
- Establishment of monitoring and evaluation requirements [36 CFR 219.11(d)].
- Recommendation of roadless areas as potential wilderness areas [36 CFR 219.17].
- Where applicable, designate lands administratively available for oil and gas leasing; and when appropriate, authorize the Bureau of Land Management to offer specific lands for leasing [36 CFR 228.102 (d) and (e)].

The authorization of site-specific activities within a plan area occurs through project decision making, which is the implementation stage of forest planning. Project decision making must comply with NEPA procedures and must be consistent with the Forest Plan.

SUPPORTING ENVIRONMENTAL ANALYSES

The following documents contain environmental analyses that are not repeated in this EIS, but provide supporting documentation for some of the Forest Plan decisions.

- Final Environmental Impact Statement for *Gypsy Moth Management in the United States: A Cooperative* Approach (Washington, DC: USDA Forest Service and APHIS, 5 volumes. November, 1995)
- Final Environmental Impact Statement for the *Suppression of the Southern Pine Beetle* (Atlanta, Georgia: USDA Forest Service, Southern Region, April 1987)
- Final Environmental Impact Statement for *Vegetation Management in the Appalachian Mountains* (Atlanta, Georgia: USDA Forest Service, July 1989)
- Final Environmental Impact Statement for Forest Service *Roadless Area Conservation* (Washington, DC: USDA Forest Service, November 2000)
- Environmental Assessment for *Management of the Federally Endangered Indiana Bat* (Roanoke, VA: USDA Forest Service, George Washington and Jefferson National Forest, March 1998)
- *Habitat Conservation Assessment For The Peaks Of Otter Salamander* (*Plethodon hubrichti*) (Roanoke, VA: USDA Forest Service, George Washington and Jefferson National Forest, 1997)

FOREST PROFILE

The Jefferson National Forest comprises lands located in Virginia (approximately 703,300 acres), West Virginia (approximately 19,000 acres) and Kentucky (almost 1,000 acres). The Jefferson National Forest contains the Mount Rogers National Recreation Area and four Ranger Districts: Clinch, Glenwood, New Castle, and New River Valley.

The National Forest is located in the Blue Ridge, Central Ridge and Valley, and Cumberland Plateau physiographic provinces, providing habitat for a wide variety of species including at least 70 amphibian and reptiles, 180 species of birds, 60 species of mammals, and 100 species of freshwater fishes and mussels. Thirty-five of the plants and animals species found on the Forest are listed by the US Fish and Wildlife Service as threatened or endangered. The Forest affords excellent opportunities for wildlife viewing, as well as hunting and fishing.

The Jefferson National Forest is a part of the Appalachian Hardwood Forest which is located within the Eastern Deciduous Forest Province. There are over 60 tree species represented on the National Forest. Hardwood-dominated forest types comprise over 70 percent of the acreage. There is much variation in the vegetation and many natural changes are taking place as forest succession progresses.

The Jefferson National Forests together have an average of 34 wildfires each year, with the average size approximating 32 acres. Ninety percent of the wildfires are human-caused. Research indicates that fire played a major role in establishing and maintaining the plant communities of the Appalachian Mountains. Major insect pests include the gypsy moth, southern pine beetle, and hemlock woolly adelgid. Major disease problems include oak decline, dogwood anthracnose, and shoestring root rot.

The Forest is located within seven major river basins -- the James, Roanoke, New, Big Sandy, Holston, Cumberland, and Clinch Rivers. The Forest contains 1,053 miles of perennial streams, of which over 500 miles are trout waters. At least 11 communities use water from the Forest for all or part of their water supplies.

The Forest transportation network has nearly 1,202 miles of National Forest System Roads which range from paved highways to non-surfaced roads designed for high clearance vehicles. Many of these roads are available for pleasure driving, the removal of forest products, bicycling and scenic viewing. Interstate 81 and other U.S. and State highways also cross or adjoin the National Forest. The National Forest is also traversed by the Blue Ridge Parkway.

Developed recreation opportunities are offered at over 100 sites on the Forest. The Forest has approximately 1,100 miles of hiking trails including about 320 miles of the Appalachian National Scenic Trail and seven National Recreation Trails. The Forest manages 11 Wildernesses totaling approximately 57,800 acres.

There is one ATV trail system of 16 miles, about 75 miles of trail open to licensed motorcycle use and 70 miles of roads identified as suitable for 4-wheel-drive vehicles.

The Jefferson National Forest encompasses approximately 30 percent of the public hunting lands located in Virginia (the combined George Washington and Jefferson National Forests comprise about 80 percent). Nearly 75 percent of all Virginia hunters hunt on the National Forests, and hunting is among the most popular recreation activities on the Forests. The Forests provide the majority of the black bear and ruffed grouse habitat in Virginia.

The Jefferson National Forest is located in the most important energy resource area of Virginia. The Forest is administering 14 Federal oil and gas leases on 15,000 acres with an additional 5,000 acres pending from public nominations or requests for federal leasing.

REASON FOR REVISION

The need to revise these plans is driven by the changing conditions identified in the Southern Appalachian Assessment (SAA) and in individual forest assessments, as well as

REASON FOR REVISION

PLANNING PROCESS

SOUTHERN APPALACHIAN FOREST COORDINATION

the changing public values associated with these national forests. The conditions and values shared across National Forest and State boundaries made it appropriate that all of these Southern Appalachian Forest Plan revisions (the Chattahoochee-Oconee (Georgia), Alabama, Cherokee (Tennessee), Sumter (South Carolina) and Jefferson National Forests) be done simultaneously. The Forest and Rangeland Renewable Resources Planning Act (RPA), as amended by the National Forest Management Act of 1976 (NFMA), requires that each national forest be managed under a Forest Plan. The purpose of a Forest Plan is to provide an integrated framework for analyzing and approving future site-specific projects and programs. Regulations require that forest plans be revised on a 10-to-15-year cycle, or sooner if conditions or the areas covered by the plan change significantly.

PLANNING PROCESS

Forest planning occurs within the overall framework provided by implementing the regulations of NFMA and NEPA. National, regional, and forest planning form an integrated three-level process. This process requires a continuous flow of information and management direction among three Forest Service administrative levels. Information from forest planning flows upward to the national level for use in the RPA program where, in turn, information flows back to the forest level. In this structure, regional planning is the principal process for conveying information between forest and national levels.

Planning actions required by the NFMA and used in this planning process are:

- Identification of issues, concerns, and opportunities;
- Development of planning criteria;
- Inventory of resources and data collection;
- Analysis of the Management Situation;
- Formulation of alternatives;
- Estimation of effects of alternatives;
- Evaluation of alternatives;
- Recommendation of preferred alternative;
- Approval and implementation;
- Monitoring and evaluation.

The results of these planning steps are described in this document. Refer to Appendix B *Analysis Process*, for more detail on the results of some of these steps.

SOUTHERN APPALACHIAN FOREST COORDINATION

Information from the Southern Appalachian Assessment, which crossed State boundaries and involved multiple national forests, along with the Jefferson National Forest efforts to update our Analysis of the Management Situation (AMS), was used to determine what decisions should be reanalyzed or changed in Forest Plan revisions across the Southern Appalachians. The main objective of the AMS was to do the analysis leading to a proposal to change forest management direction. A key part of that analysis is the SAA. The SAA culminated in a final summary report and four technical reports, which are now available to the public. It was prepared by the USDA Forest Service (the Southern Region of the National Forest System and the Southern Forest Experiment Station) in cooperation with the other Federal and State agencies that are members of the Southern Appalachian Man and the Biosphere Cooperative. The SAA includes National Forest System lands and private lands in the George Washington/Jefferson, Nantahala-Pisgah, Cherokee, and Chattahoochee National Forests; and parts of the Sumter and Talladega National Forests.

It also involves the National Park Service lands in the Great Smoky Mountains National Park, Shenandoah National Park, and Blue Ridge Parkway.

SOUTHERN APPALACHIAN FOREST COORDINATION

The SAA facilitated an interagency ecological approach to assessing conditions in the Southern Appalachian area by collecting and analyzing broad-scale biological, physical, and socioeconomic data to facilitate better, more ecologically based, forest-level resource analysis and management decisions. The SAA is organized around four themes: (1) Terrestrial (including Forest Health and Plant and Animal Resources); (2) Aquatic Resources; (3) Atmospheric Resources; and (4) Social/Cultural/Economic Resources (which includes the Human Dimension, Roadless Areas and Wilderness, Recreation, and Timber Supply and Demand). As the national forests in the Southern Appalachians were each conducting their individual AMS, they were also providing information for the larger-scale analysis in the Southern Appalachian Assessment. The SAA supports the revision of the Forest Plans by describing how the lands, resources, people, and management of the national forests interrelate within the larger context of the Southern Appalachian area. The SAA, however, is not a "decision document," and it did not involve the National Environmental Policy Act (NEPA) process. As broad-scale issues were identified at the subregional level (Southern Appalachian Mountain area) in the SAA, the individual national forest's role in resolving these broad-scale issues becomes a part of the "need for change" at the forest level. Public involvement has been important throughout both of these processes. Continuing public involvement leading to formulation of alternatives for the Forest Plan revision was conducted through the "scoping" period that followed the issuance of the Notice of Intent on August 1, 1996.

On February 24, 1995, a Notice of Intent was placed in the *Federal Register* (Vol. 60, No. 37) that identified the relationships between the SAA and the Forest Plan revisions of the National Forests in Alabama, Chattahoochee-Oconee National Forests, Cherokee National Forest, Jefferson National Forest, and Sumter National Forest. Significant issues that crossed National Forest boundaries were developed in common for all of the Southern Appalachian forests. Each Forest also developed issues unique to them. In response to the 12 common issues, common alternatives and management prescriptions were developed.

SUMMARY OF SIGNIFICANT ISSUES

SUMMARY OF SIGNIFICANT ISSUES

Public involvement is a key part of the planning process. Providing for public comment helps identify what people want from the national forests in the form of goods, services, and environmental conditions. Issues submitted by the public, as well as from within the Forest Service and other federal and state agencies, guided the need to change current management strategies. Some of the issues listed below were obtained from appeals of the Forest Plans. Other issues were submitted by the public during scoping efforts conducted by Forest Service personnel.

In addition to the emerging issues, the need for change was identified through the Analysis of the Management Situation. This analysis provided a basis for formulating a broad range of reasonable alternatives. A detailed account of the public involvement process is in Appendix A, "Summary of Public Involvement."

The SAA provided key information concerning those portions of the national forests that are within the SAA area that will be used in plan revisions. The SAA teams compiled existing region-wide information on resource status and trends, conditions, and impacts of various land management activities and resource uses that apply to portions of each of the national forests.

SUMMARY OF SIGNIFICANT ISSUES

ISSUES COMMON ACROSS THE SOUTHERN APPALACHIANS

The following significant issues are common to the forests of the southern Appalachians. These issues, along with those unique to the Jefferson National Forest were used to develop alternatives for the Forest Plan revision process.

Terrestrial Plants and Animals and Their Associated Habitats. How should the national forests retain or restore a diverse mix of terrestrial plant and animal habitat conditions, while meeting public demands for a variety of wildlife values and uses?

Threatened, Endangered, and Sensitive/Locally Rare Species. What levels of management are needed to protect and recover the populations of federally listed threatened, endangered and proposed species? What level of management is needed for Forest Service sensitive and locally rare species?

Old Growth. The issue surrounding old growth has several facets, including: (1) How much old growth is desired? (2) Where should old growth occur? (3) How should old growth be managed?

Riparian Area Management, Water Quality and Aquatic Habitats. What are the desired riparian ecosystem conditions within national forests, and how will they be identified, maintained and/or restored? What management direction is needed to help ensure that the hydrologic conditions needed for the beneficial uses of water yielded by and flowing through National Forest System lands are attained? What management is needed for the maintenance, enhancement, or restoration of aquatic habitats?

Wood Products. The issue surrounding the sustained yield production of wood products from national forests has several facets, including: What are the appropriate objectives for wood product management? Where should removal of wood products occur, given that this production is part of a set of multiple use objectives, and considering cost effectiveness? What should be the level of outputs of wood products? What management activities associated with the production of wood product are appropriate?

Aesthetics/Scenery Management. The issue surrounding the management of the visual quality has two facets: What are the appropriate landscape character goals for the national forests? What should be the scenic integrity objectives for the national forests?

Recreation Opportunities/Experiences. How should the increased demand for recreational opportunities and experiences be addressed on the national forests while protecting forest resources? This includes considering a full range of opportunities for developed and dispersed recreation activities (including such things as nature study, hunting and fishing activities, and trail uses).

Roadless Areas and Wilderness Management. Should any of the roadless areas on National Forest System lands be recommended for wilderness designation? For any roadless areas not recommended for wilderness, how should they be managed? How should areas that are recommended for wilderness designation be managed? How should the patterns and intensity of use, fire, and insects and disease be managed in the existing wilderness areas?

Forest Health. What conditions are needed to maintain forest capacity to function in a sustainable manner as expected or desired? Of particular concern are the impacts of exotic or nonnative species, and the presence of ecological conditions with a higher level of insect and disease susceptibility.

Special Areas and Rare Communities. What special areas should be designated, and how should they be managed? How should rare communities, such as those identified in the Southern Appalachian Assessment, be managed?

Wild and Scenic Rivers. Which rivers are suitable for designation into the National Wild and Scenic Rivers System, and how should rivers that are eligible, but not suitable, be managed?

Access and Road Management. How do we balance the rights of citizens to access their national forests with our responsibilities to protect and manage the soil and water resources, wildlife populations and habitat, aesthetics, forest health, and desired vegetative conditions?

ISSUES UNIQUE TO THE JEFFERSON NATIONAL FOREST

In addition, the following local issues were determined for the Jefferson National Forest:

Minerals. How will the mineral resources of the national forest be managed considering public demand for a wide variety of minerals? What areas will be made available for the exploration and development of federal leasable minerals and mineral materials?

Special Uses. How should the Forest Plan address special uses of the national forest?

Fire Management. How will fire be used in land management activities such as wildlife management, fuels management, silviculture, and ecosystem restoration and maintenance? What measures should be taken to minimize air pollution impacts from prescribed fire?

The JNF Effect On Local Communities & People's Effect On JNF. What is the role of the Jefferson in supporting local communities in a changing economic environment? Can a balance be found between commodity-related jobs and tourism-based jobs and the amenity related values important to quality of life? How should the changing demographics, attitudes, and needs of people around the Jefferson National Forest be reflected in a changing mix of goods and services? How will management respond to the changes in population and social structures occurring within and adjacent to the national forest?

Subsurface Property Rights. How will subsurface property rights, reserved and outstanding, and mineral leases held by production be taken into consideration when looking at alternative land allocations?

Mount Rogers National Recreation Area. What mix of goods and services are appropriate on the Mount Rogers NRA considering the qualities of the area that established its special designation? How should the Crest Zone be managed?

Lands - Priorities For Acquisition, Deposition, And Exchange. What are the priorities for land adjustments including acquisition, deposition, and exchange?

Air Quality. How will the revised Forest Plan guide monitoring and mitigation of air pollution effects on forest resources and facilitate interaction with the regulatory community? How will Forest management prescriptions (desired conditions, goals, objectives, standards, guidelines and possible management practices) incorporate air pollution considerations?

PLANNING PROCESS RECORDS

PLANNING PROCESS RECORDS

The Forest's Interdisciplinary Team is responsible for developing the revised Forest Plan. Efforts were made to provide detailed explanations of each step of the revision in the form of process (or planning) records. This FEIS contains summaries of the process records and includes references to the parent records. Process records are on file in the Forest Supervisor's Office. To review these records, contact:

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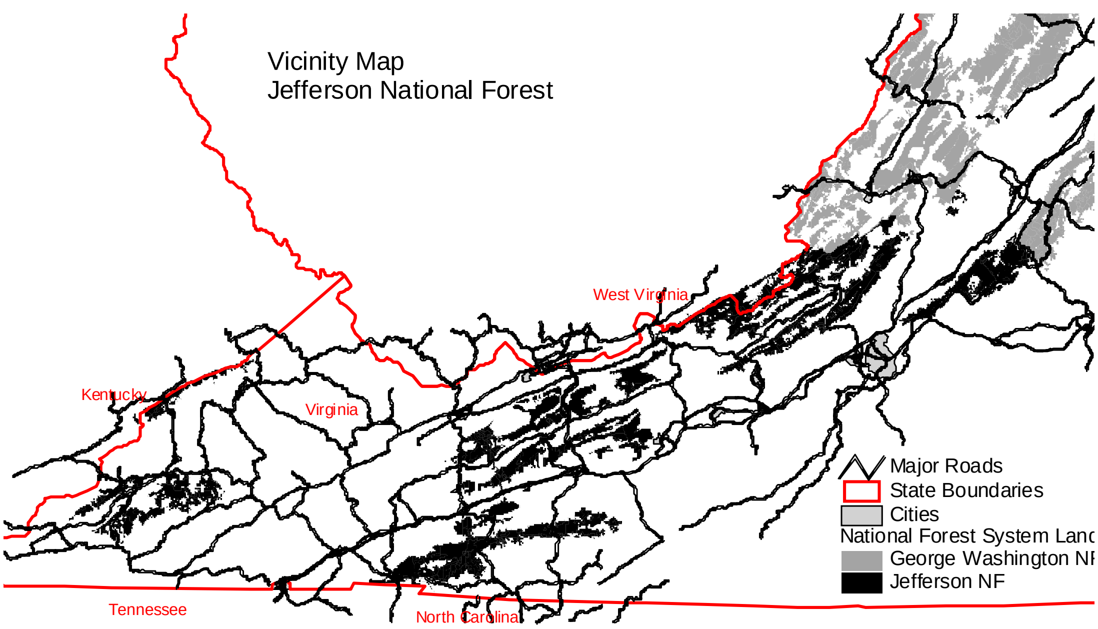

ALTERNATIVES

CHAPTER 2

INTRODUCTION

CONSISTENCY ACROSS THE SOUTHERN APPALACHIANS

INTRODUCTION

This chapter describes the seven alternatives considered in detail in this Environmental Impact Statement, as well as the process used to develop alternatives. The alternatives suggest a variety of scenarios for managing the Jefferson National Forest and how they respond to the significant issues described in Chapter One. This chapter also explains the alternative development process, provides reasons for why some alternatives were originally considered and then later eliminated from detailed study, describes those alternatives considered in detail, and compares how each alternative responds to the significant issues. Appendix B provides more details on procedures used to develop and model the alternatives.

CONSISTENCY ACROSS THE SOUTHERN APPALACHIANS

In an effort to have a consistent approach to the development of revised forest plans across the forests of the Southern Appalachians, various teams were assembled and tasks assigned. In addition to the Jefferson Interdisciplinary Team, individual resource specialists from the Regional Forester's office, Cherokee National Forest, Chattahoochee-Oconee National Forests, Sumter National Forest, and National Forests in Alabama worked together in developing and analyzing forest plan alternatives and coordinated a consistent approach to these Forest Plans. These teams consisted of:

The **Steering Team** comprised of the Forest Supervisors of the five national forests in the Southern Appalachians and the Director of Planning in the Regional Office. This team provided oversight and direction to the overall planning effort.

The **Southern Appalachian Planners Team** (SAP) comprised of the Interdisciplinary Team Leaders from each of the five national forests and two Regional Office planners. This group held numerous meetings, most of which were open to the public, to develop and implement a coordinated approach to developing and analyzing the alternatives.

The **Fisheries, Wildlife, Range, Botany, and Ecology Team** (FWRBE) made up of fisheries biologists, wildlife biologists, range conservationists, botanists, and forest ecologists from the five national forests and the Regional Office. This team developed a consistent approach to addressing those issues relating to terrestrial and aquatic species and their habitats including threatened, endangered, and sensitive species; species of viability concern; old growth; and rare communities. Most of these meetings were also open to the public.

The **Southern Appalachian Recreation, Rivers, Wilderness Advisory Group** (SARRWAG) included recreation specialists and landscape architects from the five national forests and the Regional Office. This team developed a consistent approach to addressing recreation and scenery issues, evaluating roadless areas, managing wilderness areas, studying Wild and Scenic Rivers, and managing the Appalachian National Scenic Trail.

The **Riparian Team** comprised of hydrologists, aquatic biologists, and soil scientists

CONSISTENCY ACROSS THE SOUTHERN APPALACHIANS

COORDINATED DEVELOPMENT OF ALTERNATIVES

from the five national forests and the Regional Office developed a consistent approach to addressing watershed, water quality, and riparian related issues.

Several of these teams also included members of neighboring national forests in the Southern Region brought in specifically to help with the Southern Appalachian planning effort. We, on the Jefferson National Forest, would like to thank everyone who worked on these teams, but particularly these folks from other Forests.

In addition to these team efforts, some specific pieces of the planning process were coordinated and developed together to achieve a consistent approach to management of the national forests across the Southern Appalachian ecosystem. These included:

- All five forests worked on the same schedule starting with the issuance of the Notice of Intent to revise the forest plans on August 2, 1996, continuing through publication of these Final Environmental Impact Statements.
- All five forests share a set of common issues described in Chapter 1.
- All five forests share a set of common alternatives. The coordinated development of these alternatives is described below.
- All five forests share a set of common management prescriptions. The coordinated development of these management prescriptions is described below.

COORDINATED DEVELOPMENT OF ALTERNATIVES

The alternative development process consisted of four different phases. It involved a joint effort of the five forests with frequent meetings in Knoxville, Tennessee and Asheville, North Carolina that were open to the public.

Phase I looked at each significant issue and identified a variety of ways each could be addressed. Phase II combined the different ways of addressing individual issues into related groups, forming four alternative themes. The four original themes included:

Theme A Produce high levels of goods and services compatible with local economies and communities.

Theme B Priority is given to restoring natural resources and processes.

Theme C Nature operates in conjunction with minimal human intervention.

Theme D Provide vigorously growing trees, commercial wood products and a variety of wildlife habitats in a generally natural-appearing setting.

These themes, along with preliminary management prescriptions, were presented to citizens in June 1998 at two workshops. At these two workshops in Roanoke and Abingdon, VA, over 50 citizens working in small groups developed processes for mapping the four alternative themes. Phase III was the actual mapping of the themes in Interdisciplinary Team meetings open to the public. These Phase III maps showed land allocations and contained a management emphasis, desired condition, and applicable management direction.

Phase IV of the alternative development process involved preliminary analysis of these four themes to determine whether modifications were needed, whether other alternatives needed to be developed, and to identify any areas of consensus. These original four themes were the “starting points” for developing additional alternatives. Citizens participated in this process through open meetings in Knoxville and an open house/forum in locations around the Forest in October 1998.

Table 2-1. Management Prescriptions used on the Jefferson National Forest in Development of Alternatives

Prescription Code	Description	Prescription Code	Description
0B	Custodial Management – Small Land Areas	7E2	Dispersed Recreation Areas - suitable
1A	Designated Wilderness/Wilderness Study Areas	7F	Blue Ridge Parkway Visual Corridor
1B	Recommended Wilderness Study Areas	7G	Pastoral Landscapes
2C1	Eligible Wild River	8A1	Mix of Successional Forest Habitats
2C3	Eligible Recreational River	8A2	Area Sensitive, Mid- to Late-Successional Emphasis
4A	Appalachian Trail Corridor	8B	Early-Successional Habitat Emphasis
4B2	Proposed Research Natural Area	8C	Black Bear Habitat Management Areas
4C1	Geologic and Paleontologic Areas - unsuitable	8E1	Ruffed Grouse Habitat Management Area
4C2	Geologic and Paleontologic Areas - suitable	8E2a	Peaks of Otter Salamander Primary Conservation Area
4D	Botanical and Zoological Areas	8E2b	Peaks of Otter Salamander Secondary Conservation Area
4E1a	Cultural and Heritage Areas - unsuitable	8E4a	Indiana Bat Primary Cave Protection Area
4E1b	Cultural and Heritage Areas - suitable	8E4b	Indiana Bat Secondary Cave Protection Area
4F	Scenic Areas	8E5	Watchable Wildlife Emphasis
4J	Urban/Suburban Interface	8E6	Old Field Habitat Emphasis
4K1	North Creek Special Area	9A1	Source Water Protection Watersheds
4K2	Hoop Hole Special Area	9A2	Reference Watersheds
4K3	Crest Zone Special Area	9A3	Watershed Restoration Areas
4K4	Whitetop Mountain Special Area	9A4	Aquatic Habitat Areas
4K5	Whitetop Laurel Special Area	9B2	High-Elevation Balds
4K6	North Fork Pound Special Area	9B3	High-Elevation Spruce-Fir/N. Hardwood Forest Habitats
5A	Administrative Sites	9F	Rare Communities
5B	Designated Communication and Electronic Sites	9G1	Maintenance and Restoration of Bottomland Hardwoods
5C	Designated Utility Corridors	9H	Mgmt, Mtnce, and Restoration of Forest Communities
6A	Old Growth Communities Not Associated with Disturbance	10A	Sustained Yield Timber Management
6B	Old Growth Communities Dependant on Fire	10B	High Quality Forest Products Emphasis
6C	Old Growth Communities Associated with Disturbance	10D	Grazing and Forage Emphasis
7A	Scenic Byway Corridors	10E	Timber Management with Recreation Emphasis
7B	Scenic Corridors and Sensitive Viewsheds	11	Riparian Areas
7C	OHV Use Areas	12A	Remote Backcountry Recreation – Few Open Roads
7D	Concentrated Recreation Zones	12B	Remote Backcountry Recreation – Nonmotorized
7E1	Dispersed Recreation Areas - unsuitable	12C	Remote Backcountry Recreation – Natural Processes

COORDINATED DEVELOPMENT OF ALTERNATIVES

COORDINATED DEVELOPMENT OF MANAGEMENT PRESCRIPTIONS

CONSISTENCY ACROSS STATE LINES

Based on these public meetings in Virginia and similar meetings on other Forests across the southern Appalachians, two additional alternatives were developed. The original four themes became Alternatives A, B, C, and D. The current direction, or “No Action” alternative became Alternative F. The three new alternatives were lettered E, G and H. The concept of an alternative that would focus all communities of interest on trying to reach common ground became Alternative I. This alternative incorporated those parts of the other alternatives where we seemed to have general agreement from everyone. It also responded to the national “Natural Resource Agenda” and the Regional Forester’s goals for managing the Southern Region. Design criteria were developed for this new alternative in a meeting of the Southern Appalachian Planners working with regional citizen groups and other interested members of the public. A part of the design of this alternative was that it was meant to “roll” or change as various communities of interest worked together with the Forest Service. As a result of this development strategy, this alternative was often referred to as the "Rolling Alternative.”

The National Forest Management Act (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 EIS incorporate these broad strategic objectives.

COORDINATED DEVELOPMENT OF MANAGEMENT PRESCRIPTIONS

Management prescriptions define the desired condition and standards for each land allocation. The five forests of the Southern Appalachians have a shared set of management prescriptions, which were developed concurrently and in the same manner as the alternative themes. Although each Forest localized the management prescriptions to meet specific conditions and issues, the numbering system, titles, and general theme of each prescription is consistent across the Southern Appalachians.

CONSISTENCY ACROSS STATE LINES

Land allocations along adjoining national forest boundaries are designed to be compatible with one another. The Jefferson National Forest adjoins the Cherokee National Forest along the Tennessee-Virginia boundary to the south. Three inventoried roadless areas, Rogers Ridge, London Bridge Branch, and Beaverdam Creek span both the Jefferson and Cherokee National Forests. These areas are managed consistently across alternatives through application of identical management prescriptions. The Appalachian National Scenic Trail also links both Forests together and is consistently managed under management prescription 4A. on both the Jefferson and Cherokee. The Jefferson also adjoins the George Washington National Forest along the James River and Rich Patch Mountain to the north. Although the George Washington Forest Plan is not currently undergoing revision and therefore has slightly different management prescriptions, management along the boundary of these two Forests has been coordinated to be consistent or complimentary.

ALTERNATIVES CONSIDERED BUT ELIMINATED FROM DETAILED STUDY

ALTERNATIVES CONSIDERED BUT ELIIMINATED FROM DETAILED STUDY

Description of Alternative C

Alternative C would emphasize resource management with minimal human intervention to the natural resources. Active management would only occur for the protection of resources, for meeting legal requirements, and for maintaining current recreation opportunities.

Potential old-growth areas would, within a few decades, come to represent the majority of the forest as a result of minimal management activity. There would be no regular, periodic harvest of green timber; therefore, no "suitable" forest land. The landscape character would change, moving toward high scenic integrity. Emphasis would be on dispersed and non-motorized recreation opportunities. No new developed recreation facilities would be constructed.

All inventoried roadless areas would be recommended for wilderness designation. The outstandingly remarkable values of all rivers eligible for Wild and Scenic River designation would be protected. Risk of loss of critical habitat for threatened and endangered species, danger to forest visitors, risk of damage to private property through Forest Service inaction, or introduction of an exotic pest would be considered unhealthy forest conditions, requiring human intervention. Human intervention would also be used to maintain or increase existing rare communities. Roads not needed for legal requirements and other resource needs would be closed or decommissioned.

REASONS ALTERNATIVE C ELIMINATED FROM DETAILED STUDY

The management prescriptions applicable to this alternative were allocated and mapped, and some preliminary estimates of the impacts of this alternative were made. After considering this preliminary information, it was determined that Alternative C did not need to be further evaluated in detail in this EIS. The reasons are: 1) From further analyses it was determined that this alternative, as originally envisioned, would not meet all the legal requirements of the National Forest Management Act of 1976 (NFMA), the Multiple-Use Sustained-Yield Act of 1960 (MUSYA) and the Endangered Species Act of 1973 (ESA); 2) Alternative C only addresses some, but not all, of the forest planning issues that have been identified by the public; 3) Other alternatives considered in detail provide for relatively low levels of management activities; and 4) Alternative C is similar to the "Minimum Level Benchmark" discussed in Appendix B.

The 219 regulations specify that the planning team should "formulate a broad range of reasonable alternatives according to NEPA procedures" (36 CFR 219.12(f)). With respect to meeting NEPA procedures, the alternatives developed need to respond to the "purpose and need". The "purpose and need" of revising the forest plan is to address the changing conditions that were identified in the Southern Appalachian Assessment, the Forest's Analysis of the Management Situation, and the changing public values as represented by the 20 significant issues. Alternative C, with its emphasis on "minimal human intervention" would not address all these issues, and would not meet the "purpose and need" as required by NEPA.

Another expression of the "purpose and need" of the forest plans is in the NFMA regulations where it states that the "resulting plans shall provide for multiple use and sustained yield of goods and services from the National Forest System in a way that maximizes long term net public benefits in an environmentally sound manner" (36 CFR

219.1). The Multiple-Use Sustained Yield Act states that the Secretary of Agriculture should "develop and administer the renewable surface resources of the national forests for multiple use and sustained yield of the several products and services obtained there from" (Section 2). Again, with its focus on "minimal human intervention", Alternative C is not an alternative that would provide "for multiple use and sustained yield of goods and services".

Additionally, the requirement to "maintain viable populations of existing native and desired non-native vertebrate species in the planning area" (36 CFR 219.19) would not be met. When this alternative was originally developed, it was thought that relatively few acres would need to be "actively managed" in order to meet this requirement. However, after more analysis was conducted on the habitat needs of various species, it was determined that there are a number of species that depend on ecological communities that can only be maintained by frequent levels of disturbance. As is explained in Chapter 3 of this EIS, a significant level of management is needed (at least over the next 10 to 50 years) to restore and maintain these disturbance-dependant communities. A certain amount of "human intervention" is needed to get these communities into the desired conditions of composition and structure, so that in the future, natural disturbances along with appropriate prescribed fire levels could maintain these communities. However, the levels of management activities that would be needed over the next 10 to 50 years to create these conditions would be inconsistent with the overall goal of Alternative C to have "minimal human intervention".

To further illustrate the need for a certain level of active management, Chapter 4 of the Southern Forest Resource Assessment (Effects of Forest Management On Terrestrial Ecosystems) states:

- "The exact nature and condition of these forests and disturbance regimes are unknown, but the presence of large grazing herbivores and fire-adapted forest communities suggests that much of this forest land was relatively open and subject to regular disturbances" (p. 92).
- "Today there are more forested acres in the South than in the early 1900s. These forests, however, are greatly altered from forests encountered by European settlers. ... The common theme for the last 10,000 years is that forests were managed to meet human needs, including those of Native Americans" (p. 93).
- "We should recognize, however, that removal of all human disturbances will have profound effects on the region's biota" (p. 93).
- "To avoid regional population declines and species losses, land managers must have the flexibility to promote active management. This region's biota does not thrive in a static system, and intentional neglect does nothing but promote additional extinctions and endangerment to species at risk. This flexibility should not extend to the other extreme of promoting intensive forestry for wildlife conservation, but it does suggest that some level of active management will be necessary to maintain many still extant but imperiled species, including many found on present or set-aside lands" (p. 93).

With respect to the agency's "Healthy Forests Initiative", a management emphasis of the agency is to change the situation where forests, overloaded with fuels, are vulnerable to severe wildland fires. Minimizing "human intervention" would increase susceptibility of the forest to insect and disease outbreaks, which would create increased fuel-loading problems, and increase the risks to other resources and to adjacent private lands. Alternative C would not address these problems and areas of concern.

Apart from the low levels of human intervention, the other aspects of this alternative such as large acreages in old-growth or late–successional conditions, maintaining roadless area characteristics, and providing for an emphasis on dispersed recreation activities, etc., are similarly represented in Alternatives E and G.

While Alternative C would address some of the issues, there are other management issues that have been raised by the public that this alternative does not address. In addition to the forest health and wildlife habitat management concerns expressed above, Alternative C does not address the issue that there are demands for various forest products such as high-quality sawtimber, which are of limited supply from private lands, but are available from National Forest lands.

Lastly, the Minimum Level Benchmark is "the minimum level of management which would be needed to maintain and protect the unit as part of the National Forest System together with associated costs and benefits" (36 CFR 219.12(e)(1)(i)). This is essentially the same management emphasis as Alternative C and a further description of this level of management can be found in Appendix B.

As a result of all these factors, it was determined that further study of this alternative was not needed.

Description of Alternative H

Alternative H would provide for active resource management to achieve multiple-use objectives with all lands classified as unsuitable for timber production. There would be timber harvest, but not under a sustainable harvest schedule as is done on suitable forest land. The active resource management would focus on providing a wide diversity of wildlife habitats. Small human-made openings would be made to mimic natural gap openings. Emphasis would be on area sensitive, interior species habitats and these areas would be managed for high to very high scenic integrity.

Old-growth allocation and management would be primarily within wilderness and backcountry recreation areas. Restoration of degraded watersheds would be emphasized to improve aquatic habitats and water quality. Highways and roads in the forests, trail and river corridors, and recreation-use areas would have forest stands with few, if any, broken views to support enhancements in tourism and local, rural economies. Recreation areas and opportunities would be increased throughout a variety of settings.

Inventoried roadless areas adjacent to existing wilderness would be recommended for wilderness designation. Exotic pests and/or undesirable species would be controlled. The outstandingly remarkable values of all rivers eligible for Wild and Scenic River designation would be protected. Public access (travelways, use corridors, waterways, and trails including off-highway vehicles) would be increased in high-use areas and/or improved to provide for more opportunities for recreation.

REASONS ALTERNATIVE H ELIMINATED FROM DETAILED STUDY

The land allocations for this alternative were identical to Alternative A, therefore it was never actually mapped. The allocations were essentially the same, and therefore, the environmental effects would be essentially the same. The only significant difference between Alternative A and Alternative H was that in Alternative A, the majority of those acres being managed through silvicultural harvesting methods were classified as acres "suitable for timber production", while in Alternative H, those same acres and same management activities would be classified as "unsuited for timber production". The timber harvesting levels planned for in Alternative H are close to the levels of harvesting

ALTERNATIVES CONSIDERED BUT ELIIMINATED FROM DETAILED STUDY

planned for in Alternative A. Since the main difference is primarily an administrative classification change, and there would be no differences in the overall outputs and environmental effects, it was decided that this alternative did not need to be considered further in detail in this EIS.

ALTERNATIVES CONSIDERED IN DETAIL

ALTERNATIVES CONSIDERED IN DETAIL

Alternative A

- Emphasize goods and services to local economies.
- Manage timber for sustained yield of high quality sawtimber.
- Manage wildlife for public demand of game and non-game species.
- Enhance developed and dispersed recreation opportunities.
- Enhance high quality scenery.
- Increase public access to the forest to enhance recreation opportunities.
- Expand watershed restoration to improve fisheries.
- Withdraw old growth lands from the suitable land base.
- Manage vegetation actively to reduce the risk of insects and diseases.

Alternative A emphasizes production of goods and services beneficial to local economies and communities. Local communities include any community that benefits economically from forest visitors and forest products. Timber management provides sustained yield of wood products with emphasis on high quality sawtimber and public-demand species including game and other species. Developed and dispersed recreation opportunities and high-quality scenery are provided in a variety of settings that are both natural and managed. These include both commercial recreation and increased public access.

Restoration of degraded watersheds is emphasized to improve aquatic habitats and water quality. This alternative emphasizes the restoration and maintenance of forest ecosystems to provide high quality water and diverse, resilient, self-reproducing aquatic populations in damaged and undamaged streams. Riparian areas are managed to retain, restore and/or enhance the inherent ecological processes and functions of the associated aquatic, riparian, and upland components within riparian corridors.

Old growth allocation and management are provided primarily on lands unsuitable for timber production as a result of other land allocations like wilderness and backcountry. Highways and roads in the forests, trail and river corridors, and recreation-use areas have forest stands with few, if any, broken views to support enhancements in tourism and local, rural economies. Inventoried roadless areas adjacent to or in close proximity to high-use wilderness areas are recommended for wilderness designation. Eligible rivers that have outstandingly remarkable recreation-related values have highest priority for wild and scenic river designation suitability evaluation.

Vegetation is actively managed to reach and maintain a condition of low risk of insect and disease problems, especially in those areas where timber production would be the emphasis, or vegetation management is permitted. This alternative responds to the "Healthy Forests Initiative," allowing for the management of forest vegetation and fuels. Fuel loads, the risks to other resources or to adjacent private lands, and the potential for severe wildland fires are decreased. Prescribed fire is used to reduce fuel-loading and to maintain fire-dependant communities. Public access (travelways, use corridors, waterways, trails including off-highway vehicles) is increased in high-use areas and/or improved to provide for more recreation opportunities.

Alternative B

- Biologically driven to emphasize restoring the natural resources and processes.
- Emphasize creation and maintenance of wildlife habitats.
- Emphasize restoration of vegetation to potential natural vegetation.
- Mimic natural processes in a natural landscape pattern.
- Create large and small openings.
- Variety of recreation opportunities available if compatible with restoration.
- Wood products produced as result of restoration or wildlife habitat creation.
- Emphasize old growth with a goal to create pre-settlement conditions.
- Emphasize riparian ecosystems.
- Enhance scenic qualities over time (possible short-term impacts).
- Roadless areas with high scenic value or wildlife needs are not recommended for wilderness designation.
- The role of insects and diseases in ecosystems would be accepted, except in epidemic conditions.
- Generally, the amount of long-term permanent access would be reduced.

Alternative B is biologically driven, emphasizing restoration of natural resources and processes, and creating and maintaining wildlife habitats. Emphasis is on restoration of vegetation to potential natural vegetation (plant associations) based on the ecological potential and capability of the land and providing a mix of the wildlife habitats for game and non-game species. Restoration activities occur in areas where technology is available to implement. When possible, natural processes are mimicked in a natural landscape pattern. Restoration activities produce both large and small openings. Long-term restoration goals are established for areas where technology is not currently available or for areas where restoration activities cannot be implemented or completed within the life of the revised Forest Plan. A variety of recreation settings occur in areas compatible with restoration activities and in non-restoration areas. Management of wood products occurs only in concert with restoration and creating wildlife habitats. Timber sales become a by-product of restoration management and wildlife habitat management.

The long-term goal provides old-growth conditions by old-growth community types within the ecological province or section similar to that existing before large-scale, extensive pioneer settlement and land uses. This alternative emphasizes the restoration and maintenance of forest ecosystems to provide high-quality water and diverse, resilient, self-reproducing aquatic populations in damaged and undamaged streams. Riparian areas are managed to retain, restore and/or enhance the inherent ecological processes and functions of the associated aquatic, riparian, and upland components within riparian corridors.

Timber production results from management to restore and maintain specific impaired or degraded resources, natural processes, communities, and wildlife habitats. In some areas of the forests, scenic resources move gradually toward high to very high scenic integrity. Restoration of areas results in short-term, low to moderate scenic integrity but with a long-term goal of high scenic integrity. A wide variety of recreation opportunities are provided. Roadless areas with identified restoration needs or wildlife habitat needs in conflict with wilderness designation would not be recommended for wilderness; other roadless areas could be recommended for wilderness study. Eligible rivers that have outstandingly remarkable ecological-related values have highest priority for wild and scenic river designation suitability evaluation.

The roles of native insects and disease are accepted, except that epidemics would be suppressed to reduce large-scale catastrophic tree mortality. Non-native invasive species such as beech scale, gypsy moth, hemlock woolly adelgid, Japanese privet, and kudzu are suppressed and eradicated when possible. This alternative responds to the "Healthy Forests Initiative," allowing for the management of forest vegetation and fuels. Fuel loads, the risks to other resources or to adjacent private lands, and the potential for severe wildland fires are decreased. Prescribed fire is used to reduce fuel-loading and to maintain fire-dependant communities. Access to degraded resources, areas in need of restoration, or areas where wildlife habitat needs occur could be temporarily provided to maintain or restore desirable ecological conditions. Access is reduced as needed to restore and protect aquatic systems, soils, and plant/animal communities.

Alternative D

- All suitable lands available for sustained yield management.
- Major forest types have a specific target "rotation" age. Harvest ensures that forest types are harvested and replaced with a new forest.
- Forest management ensures approximate equal areas in each age class.
- Age classes are distributed across the forest in 15-40 acre blocks.
- Production of wood products and a variety of aquatic and wildlife habitats is emphasized.
- Provide developed and dispersed recreation opportunities.
- Medium and large-sized blocks of old growth provided only on unsuitable land.
- Semi-primitive experiences are primarily on unsuitable land.
- Insects, diseases and exotic plant and animal species on suitable lands are actively controlled.
- Maintain and increase forest access to facilitate management activities.

Alternative D strives to reach and maintain a balanced age class for tree growth. All suitable lands are available for sustained-yield management. On suitable lands, each of the major forest groups (pine, mixed, and hardwood) would have a specific target "rotation age" or age when timber harvest is used to begin a new forest.

There is an approximately equal number of acres within each 10-year age class up to the rotation age. This "balance of age classes" occurs on lands identified as suitable and are distributed in 15- to 40-acre blocks throughout the lands managed for sustained-yield timber production. Pine, mixed, and hardwood forests older than the rotation age also occur on large blocks of land already withdrawn from sustained-yield timber production. Production of both commercial wood products and a variety of aquatics/wildlife habitats are also emphasized.

Developed and dispersed recreation opportunities are provided in a variety of settings that are both natural and managed. This alternative emphasizes the restoration and maintenance of forest ecosystems to provide high-quality water and diverse, resilient, self-reproducing aquatic populations in damaged and undamaged streams. Riparian areas are managed to retain, restore and/or enhance the inherent ecological processes and functions of the associated aquatic, riparian, and upland components within riparian corridors.

Large- and medium-sized blocks of old growth are provided only on unsuitable land. Small blocks occur scattered throughout the suitable lands on steep slopes, riparian areas, or similar areas. The forest appears highly variable in tree sizes and openings in the canopy are seen from roadways and vista points. Potential for roaded natural experiences increases as access roads for timber harvest are built or improved. The semi-primitive experiences are primarily on unsuited lands. Roadless areas that have few conflicts with lands suitable for timber production are recommended as wilderness. Eligible rivers that have few conflicts with lands suitable for timber production have highest priority for wild and scenic river designation suitability evaluation.

Insects, diseases, and exotic plant and animal species on suitable lands are actively controlled and prevented. This alternative responds to the "Healthy Forests Initiative," allowing for the management of forest vegetation and fuels. Fuel loads, the risks to other resources or to adjacent private lands, and the potential for severe wildland fires are decreased. Prescribed fire and timber harvesting are used to reduce fuel-loading and to maintain fire dependant communities. Access would be developed, maintained, and used as needed to meet the goal of balanced age classes, wildlife habitats, and production of timber products.

Alternative E

- Resource management designed to attract recreation users.
- Emphasis on backcountry recreation.
- Most roadless areas recommended for wilderness designation.
- Substantial amount of forest allocated to providing old growth.
- Maintain a forest canopy over most forested areas.
- Maintain large blocks of the forest in roadless condition to provide remote, backcountry recreation.
- Increase a variety of developed and dispersed recreation opportunities.
- Increase the opportunity for off-highway vehicle (OHV) use.
- Maintain a variety of wildlife habitats across the landscape.
- Focus timber management on production of high quality large diameter trees in certain areas.

A natural setting and concentrated facilities are provided that attract a variety of recreation users, with an emphasis on backcountry recreation. Most areas maintain a continuous forested canopy. Large blocks of the forest would be maintained in a roadless condition to provide remote, backcountry recreation. Most roadless areas are recommended for wilderness study. Dispersed recreation opportunities are increased. Developed recreation areas are maintained and improved. A variety of recreation experiences occur, including concentrated use and OHV use. Suitability evaluations are completed for all rivers eligible for wild and scenic river designation.

This alternative emphasizes the restoration and maintenance of forest ecosystems to provide high-quality water and diverse, resilient, self-reproducing aquatic populations. Riparian areas are managed to retain, restore and/or enhance the inherent ecological processes and functions of the associated aquatic, riparian, and upland components within riparian corridors. A variety of different wildlife habitats are maintained in blocks across the landscape. Habitat for area sensitive species is accomplished through maintenance of a variety of successional classes in a manner unnoticeable to most forest visitors. A substantial amount of the forest is allocated to providing old growth for biological and aesthetic settings in large, medium, and small patches.

Active resource management is concentrated in certain locations and supports recreation use and visual quality. The overall long-term timber product objective is large-diameter and high-quality sawtimber for tree species capable of reaching that objective. Highways and roads in the forests, trail and river corridors, viewsheds, and recreation-use areas have forest stands with few, if any, broken views to support enhancements in tourism and local, rural economies.

Many insect and disease impacts are tolerated as part of a functioning natural ecosystem. Fuel loads, the risks to other resources or to adjacent private lands, and the potential for severe wildland fires remain similar to current. Prescribed fire and wildland fire use may be used to reduce fuel-loading and to maintain fire dependant communities. Public access (travelways, use corridors, waterways, trails including OHV) are improved in concentrated high-use areas to provide for more recreation opportunities.

ALTERNATIVES CONSIDERED IN DETAIL

Alternative F – No Action Alternative – Current Management

- Continue implementing the 1985 Plan, as amended.
- Provide a balanced program of market and non-market resources with increased emphasis on high quality sawtimber and other timber products.
- Provide for threatened, endangered and sensitive species management.
- Provide a variety of developed and dispersed recreation opportunities.
- Maintain a variety of wildlife habitats across the landscape.
- Riparian area management would continue with an emphasis on standards.
- Strive for a balanced age class distribution.
- Maximize range use.

This alternative was developed for the 1985 Forest Plan (as amended) to address the "aging forest" condition. Management activities are designed to improve the age class distribution in all forest types and provide a balanced market and non-market resource program to maintain a broad geographic distribution of socio-economic benefits. A good distribution of age classes is developed while maintaining a viable forest condition that produces increases in high quality sawtimber and other timber products.

This alternative provides increased opportunities for developed and primitive recreation experiences as demand dictates. Wilderness areas in 1985 included James River Face, Beartown, Kimberling Creek, Lewis Fork, Little Dry Run, Little Wilson Creek, Mountain Lake, Peters Mountain and Thunder Ridge. In addition the two wilderness study areas recommended have consequently been designated wilderness by Congress (Barbours Creek and Shawvers Run).

This alternative provides for the maintenance of an optimum population of game and non-game species and protection of sensitive species. Range use is maximized on available acres for domestic livestock forage.

Soil productivity is maintained and on disturbed areas improved. Proposals for mineral exploration and development are responded to in coordination with other resource values. Emphasis is given to energy and strategic minerals. The lands program is managed to support multiple resources. A transportation system is provided to meet all resource needs. Protection measures needed to protect public and resource values are emphasized. Management of the Mount Rogers National Recreation Area is guided by a separate management plan, although management prescriptions are assigned to this area similarly to the remainder of the Forest.

Prescribed burning is utilized as a vegetation management tool to accomplish resource management objectives and for fuel treatments to reduce the risk from wildland fire to natural resources, life or private property. Wildland fires are managed utilizing the full array of appropriate management responses commensurate with resource values at risk, firefighter and public safety and the protection of private property.

Alternative G

- Link large undisturbed areas together with corridors.
- Provide threatened and endangered species management, species reintroduction and watershed restoration.
- Emphasize forest interior species habitat as well as a wide variety of other native plants and animals, particularly late successional species.
- Emphasize nature-oriented non-motorized recreation opportunities.
- Recommend roadless areas for wilderness.

- Emphasize high quality timber production outside sensitive species habitat.
- No intervention for native insects and diseases.
- Use fire to restore natural ecosystem processes.
- Reduce the road network.
- Maintain roadless areas as unfragmented habitat.
- Provide old growth restoration areas.

Alternative G emphasizes linking together movement corridors and large undisturbed areas, and concentrates on threatened, endangered, and sensitive species through land allocations. National Forest System lands provide habitat for area sensitive species and a wide diversity of native plants and animals, particularly late-successional species. Old growth restoration areas around clusters of existing old growth and mature forests with old growth characteristics provide natural old growth dynamics across the landscape of the Southern Appalachians. Emphasis is on inventory, monitoring, conservation, and recovery of threatened, endangered, sensitive, and locally rare species. The Forest works proactively with the U.S. Fish and Wildlife Service to reintroduce extirpated species.

This alternative emphasizes the restoration and maintenance of forest ecosystems and watersheds to provide high-quality water and diverse, resilient, self-reproducing aquatic populations. Riparian areas are managed to retain, restore and/or enhance the inherent ecological processes and functions of the associated aquatic, riparian, and upland components within riparian corridors. Riparian areas are maintained as old growth for habitat and connectivity.

Backcountry, late-successional wildlife species, and nature-oriented non-motorized recreation opportunities are emphasized. Naturally evolving and naturally appearing landscapes predominate. Recreation takes place within a context set by habitat needs and ecosystem function. Developed facilities occur where they do not detract from ecosystem function and landscape connectivity. Roadless areas are maintained as unfragmented wildlife habitat, landscape linkages, old growth restoration, wilderness designation, and other management that would maintain their un-fragmented habitat and ecosystem function. Most roadless areas are recommended for wilderness study. Eligible rivers that have outstanding botanical, ecological, fish, aquatic, or wildlife values have highest priority for wild and scenic river designation suitability evaluation.

High-quality timber is produced in long rotations in areas outside area sensitive species habitat, movement corridors, and large undisturbed areas and is accessed from existing roads. Effects of native insects and diseases are accepted. Non-native invasive pests would be controlled by means that least impact ecosystem function and un-fragmented habitat across the landscape. On lands suitable for timber production, emphasis is on establishing a naturally resilient forest that avoids large outbreaks of forest pests. Prescribed fire and wildland fire use are used to restore natural ecosystem processes. Road network mileage is reduced through closure and decommissioning of roads not needed for ecosystem stewardship or restoration.

Alternative I – Preferred Alternative

- Emphasize ecosystem restoration and maintenance.
- Emphasize watershed health and water quality.
- Emphasize threatened, endangered and sensitive species management.
- Maintain and restore riparian areas.
- Emphasize sustainability of diverse ecosystems, especially rare communities.
- Promote and maintain a variety of old growth communities.
- Prioritize maintenance of forest health.
- Provide high quality nature-based recreation opportunities.

- Emphasize non-motorized settings with natural appearing landscapes.
- Provide a high quality forest transportation network with an effort for reduction.

Alternative I recognizes and balances the wide diversity of interests and values in management of the Jefferson National Forest. This alternative emphasizes watershed health, water quality, semi-primitive and remote recreation opportunities, threatened and endangered species recovery, sustainable forest ecosystem management on lands suitable for timber production, habitat for wide-ranging species, and a high quality forest transportation network. This alternative provides high quality, nature-based recreation opportunities, emphasizing non-motorized settings with natural appearing landscapes and those that are not widely available on non-Federal lands. Semi-primitive recreation opportunities, inventoried roadless areas, outstandingly remarkable river values, and high scenic areas, including scenic views at a range of distances, are protected.

Forest ecosystems and watersheds are restored and maintained to provide high quality water and diverse, resilient, self-reproducing aquatic populations. Riparian areas are managed to retain, restore and/or enhance the inherent ecological processes and functions of the associated aquatic, riparian, and upland components within riparian corridors.

Diverse ecosystems are sustained that support viable plant, wildlife and fish populations including habitats for those species needing large contiguous forested landscapes. A variety of old growth communities to meet biological and social needs is provided. Forest health is a priority to ensure a forest that is resistant to large-scale, catastrophic plant mortality from insects or disease, especially from non-native organisms. This alternative responds to the "Healthy Forests Initiative," allowing for the management of forest vegetation and fuels. Fuel loads, the risks to other resources or to adjacent private lands, and the potential for severe wildland fires are decreased. Prescribed fire, wildland fire use and timber harvesting are used to reduce fuel-loading and to maintain fire-dependant communities. The Forest Service road system is managed at the minimum level needed to achieve the management objectives of this alternative.

COMPARISON OF ALTERNATIVES

Table 2-2, on the facing page, displays the allocation of management prescriptions by Alternative. The remainder of this section compares how each Alternative addresses the significant issues. This comparison provides a brief summary of Chapter 3 (Environmental Effects of Alternatives) of this Environmental Impact Statement.

Issue 1 - Terrestrial Plants and Animals and Their Associated Habitats

How should national forest retain or restore a diverse mix of terrestrial plant and animal habitat conditions, while meeting public demands for a variety of wildlife values and uses?

All of the alternatives analyzed in detail provide habitat for the wide variety of species that inhabit the JNF. Alternatives D and F provide the most early successional forest habitats. Alternatives G and E provide the most mature interior forest habitats. Table 2-3 compares successional habitats, interior habitats, permanent types of open habitats, and predicted population trends for the Management Indicator Species (MIS).

Table 2-4 displays the results of the terrestrial species viability analysis. Alternatives B and D have the least numbers of at risk species as a result of management. Alternatives

Table 2-2. Land Allocation of Management Prescriptions by Alternative.

Rx Code	Alt A	Alt B	Alt D	Alt E	Alt F	Alt G	Alt I
0B	3,500	3,500	3,500	3,500			3,500
1A	57,800	57,800	57,800	57,800	57,800	57,800	57,800
1B	28,200	15,600	15,700	81,600		156,100	25,200
2C1	1,200			1,200		1,200	900
2C3	9,100		4,200	10,600		7,400	4,400
4A	40,800	43,100	42,800	38,300	56,800	34,900	30,700
4B2		2,100				2,100	
4C1	1,500		1,100	1,100			1,500
4C2	11,800			11,400			
4D	5,300	6,000	4,900	4,000	700	4,800	4,700
4E1a	200	200	200	200		200	200
4E1b	7,000			1,300	1,100		1,500
4F	4,900	1,800	2,800	41,800	16,100	200	1,000
4J	4,700						3,900
4K Combined							29,500
5A	200	200	200	200	200	200	200
5B	100	100	100	100	100	100	200
5C	1,300	1,300	1,300	1,300	1,300	1,300	3,700
6A	1,100	2,100	1,700	900		10,900	300
6B	1,700	900	500	2,000		6,100	800
6C	25,500	108,200	42,100	35,700		117,000	30,200
7A	1,900		500	1,600			1,800
7B	76,800		1,900	130,300	13,500	2,500	23,500
7C	1,500		1,500	1,500	1,400		1,500
7D	17,600	7,000	8,400	23,000	10,600	5,800	6,000
7E1	14,900		600	44,000		15,500	19,600
7E2	77,500		24,400	44,000	55,300		51,800
7F	7,100	4,300	6,400	6,100		4,400	3,900
7G	5,700	100		2,600			3,700
8A1	17,000	86,500	6,200		100,500	89,300	112,600
8A2	3,700	24,700		43,900		77,300	
8B	15,300	3,200	600		40,500		19,600
8C	91,100	69,200	59,000	9,500	9,400	33,300	57,300
8E1	12,600	11,600	3,600	12,500	4,900		16,100
8E2a	1,500	3,600	3,900	2,800		2,500	2,400
8E2b	5,300	7,000	5,900	3,600	10,100	5,500	5,300
8E4a	400	400	400	400		400	900
8E4b	8,300	8,200	8,300	7,200	8,400	6,400	8,800
8E5	400	400	400	300		200	
8E6	3,700	8,600	3,700	1,700	1,900	3,100	1,300
9A1	27,900	29,100	23,700	17,300		19,000	19,200
9A2							<100
9A3	300	8,800	300	300		8,200	1,700
9A4		100	100	5,200		100	6,500
9B2		1,000			1,600		
9B3		7,500	9,400		4,000	10,800	
9F	6,300	10,000	8,500	5,300		8,400	7,400
9G1	100	700	100	100		500	100
9H		120,600	114,400			9,900	24,700
10A	7,000		208,500		204,500		
10B	55,400		19,500	1,900			16,200
10D			3,700				
10E				18,000			
11	73,600	73,600	73,600	73,600	73,600	73,600	73,600
12A	2,900		3,500	6,100	67,300	10,700	9,700
12B	54,700	65,700	16,500	40,600	54,800	4,100	91,300
12C		1,600				4,600	9,800
Total Forest Acres	**723,300**	**723,300**	**723,300**	**723,300**	**723,300**	**723,300**	**723,300**

COMPARISON OF ALTERNATIVES

ISSUE 1 TERRESTRIAL PLANTS AND ANIMALS

ISSUE 2 TES SPECIES

E, F, and G have the highest numbers of at risk species as a result of management. Alternatives A and I have 2 more species at very high, high, or moderately high risk than Alternatives B and D, while Alternative G has 7 more species and Alternative E has 18 more species.

The increased species at risk in Alternatives G and E are those associated with Table Mountain pine forest habitats, mature yellow pine forest habitats, early successional forest habitats, woodland, savannah, and grassland habitats. Alternative E has low levels of both prescribed burning and early successional habitat; timber harvest is limited to uneven-aged management, even-aged methods that retain a partial canopy, and thinning. Alternative G has high levels of prescribed fire, but emphasizes mature forest interior species and has very low levels of early successional habitat.

Table 2-3. Comparison of Issue 1 (Terrestrial Plants and Animals) by Alternative

	Alternative						
	A	B	D	E	F	G	I
Successional Habitats	Percent of Forested Acres						
Early Successional Habitat First Decade	2.9	2.3	4.4	0.5	2.9	0.4	2.1
Early Successional Habitat Fifth Decade	1.3	1.6	3.0	0.1	2.6	0.4	2.3
Mid- to Late-Successional Habitat First Decade	90	90	89	92	90	93	90
Mid- to Late-Successional Habitat Fifth Decade	91	92	80	98	89	99	92
Late Successional Habitat First Decade	72	72	71	74	72	75	72
Late Successional Habitat Fifth Decade	80	83	69	91	79	92	83
Interior Habitats	Percent of Forested Acres						
Mid- to Late-Successional Mesic Deciduous Forest in a Landscape with Greater than 70% Forest Cover	91	91	91	91	91	91	91
Mid- to Late-Successional Mesic Deciduous Forest with No Early Successional Habitat Objective	53	58	48	67	43	73	58
Permanent Openings, Old Fields and Balds	Acres In Thousands						
Current	12.0	12.0	12.0	12.0	12.0	12.0	12.0
First through Fifth Decade	11.8	9.3	11.8	11.8	11.8	6.8	12.1
Management Indicator Species	Expected Trends in Populations for the First Decade *						
Hooded Warbler	+	+	=	++	=	=	+
Scarlet Tanager	+	+	=	++	=	++	+
Pine Warbler	+	++	++	=	=	+	+
Eastern Towhee	=	=	++	- -	=	- -	=
Ovenbird	+	++	=	++	=	++	++
Acadian Flycatcher	+	+	+	+	+	+	+
Pileated Woodpecker	=	=	=	=	=	+	=

* Population trends expressed as expected to change from current levels:
"++" relatively large increase; "+" increase; "=" little to no change; "-" decrease; "- - " relatively large decrease

Issue 2 - Threatened, Endangered, and Sensitive/Locally Rare Species

What levels of management are needed to protect and recover the populations of federally listed Threatened, Endangered and Proposed species? What level of management is needed for Forest Service sensitive and locally rare species?

The national forests of the Southern Appalachians provide potential and occupied habitat for numerous threatened and endangered species. Legal mandates require national forests to maintain viable populations of proposed, threatened, endangered, and sensitive species (TES) as important components of diverse, functional ecosystems.

All of the alternatives analyzed in detail protect and recover threatened, endangered, sensitive, and locally rare species and provide habitat for the wide variety of other species that also inhabit our Forest. Alternatives A, B, D, E, G, and I all designate areas around Indiana bat hibernacula and Peaks of Otter salamander habitat, as well as employ objectives and standards for managing these species and gray bats, Virginia big-eared bats, bald eagles, peregrine falcons, northern flying squirrels, and federally-listed plants. Each of these alternatives also include the latest strategies for management and recovery of these species as a result of our close collaboration with the U.S. Fish and Wildlife Service. Two new Indiana bat hibernacula protection areas were added to Alternative I between the Draft and Final EIS.

Rare communities are a very important part of the strategy to protect and recover threatened, endangered, sensitive, or locally rare species. The Forest worked closely with the Virginia Department of Conservation and Recreation's Natural Heritage Program to identify rare communities and special biological areas because they contribute significantly to plant and animal diversity, particularly threatened, endangered, sensitive, or locally rare species. Alternatives A, B, D, E, G, and I all set aside these special areas for management to conserve and improve their natural composition, structure, and function in order to support the rare species associated with them.

Table 2-4 displays the results of our terrestrial and aquatic viability analysis as a comparison of effects on threatened, endangered, sensitive, and locally rare species between alternatives.

Table 2-4. Comparison of Issue 2 (Threatened, Endangered, Sensitive and Locally Rare Species) by Alternative

	Alternative						
	A	B	D	E	F	G	I
Terrestrial Species Viability	Number of Species/Habitat Relationships						
Species/Habitat Relationships Rated as Very High Risk	104	104	104	130	128	106	104
Species/Habitat Relationships Rated as High Risk	116	111	114	100	100	116	116
Species/Habitat Relationships Rated as Moderately High Risk	161	164	161	167	164	166	161
Total	381	379	379	397	392	386	381
Aquatic Species Viability	Number of Species/Number of Watersheds						
Low Risk	13/13	13/13	15/15	13/13	13/13	13/13	13/13
Moderate Risk, FS May Positively Influence	4/5	4/5	6/8	4/5	4/5	4/5	4/5
Potential High Risk, Little Opportunity for FS Influence	88/180	88/180	96/198	88/180	88/180	88/180	88/180
Potential High Risk, FS May Positively Influence	0/0	0/0	0/0	0/0	0/0	0/0	0/0
Potential Very High Risk, Little Opportunity for FS Influence	1/2	1/2	1/2	1/2	1/2	1/2	1/2

COMPARISON OF ALTERNATIVES

ISSUE 3
OLD GROWTH

Issue 3 - Old Growth

The issue surrounding old growth has several facets including: How much old growth is desired? Where should old growth occur? How should old growth be managed?

The public has expressed concerns and a variety of viewpoints about old growth forests on public lands. Some state the spatial distribution and linkages of patches with varying sizes are important, that old growth communities are underrepresented on private lands, and that the national forests have the best opportunity to provide for these communities. There is also a debate about how old growth should be managed, maintained, or restored. Many people state that old growth areas should be protected or “preserved” and that there should be no harvesting within these areas. Some expressed a concept of different levels of old growth management, including undisturbed “core” areas with more actively managed “buffers” of old growth around them.

There are many values that people associate with old growth, some of which are compatible, and others that present conflict. Old growth provides both biological and social values. Old growth communities provide large den trees for wildlife species such as black bear, large snags for birds and cavity nesters, and large cover logs for other wildlife. Ecologically, old growth provides elements for biologic richness, gene conservation, and riparian area enhancement. Old growth areas provide for certain recreational experiences, research opportunities, and educational study. Other areas have associated historical, cultural, and spiritual values. Some may never visit an old growth site but will receive satisfaction from “just knowing” that it exists. On the other hand, old growth areas are a source of large-diameter, high-value hardwoods, which are limited in supply and in high demand for such products as furniture and finish construction work. Others say that insect and disease risk can be relatively high in old growth stands and could (for some community types) threaten the retention of those stands as old growth. There is concern that fire exclusion could favor a buildup of fire-intolerant, but shade-tolerant, species that could eventually replace the original old growth type. This view is that active management, including timber harvest and prescribed fire, could be used to accelerate the development of old growth attributes.

Alternatives A, B, D, E, G, and I protect all 50,000 acres of existing old growth known to exist on the Forest as of today. Every Alternative also include areas that will develop old growth characteristics in the future because they are in wilderness, backcountry recreation areas, and other areas not suitable for timber harvesting. Alternatives G, E, and B have higher amounts of future old growth, Alternative D has the least.

Table 2-5. Comparison of Issue 3 (Old Growth) by Alternative

	Alternative						
	A	B	D	E	F	G	I
Old Growth	Acres In Thousands						
Acres of Existing Old Growth Protected	50.0	50.0	50.0	50.0	0	50.0	50.0
Acres Allocated to Old Growth Emphasis Prescriptions (6A, 6B, 6C)	28.3	111.2	44.3	38.6	0	134.0	31.3
Acres of Future Old Growth Allocated in Large Blocks	143.6	140.7	93.5	186.1	179.9	233.3	193.7
	Percent of Total Forest Acres						
Percent of JNF With No Specific Objectives for Creating Early Successional Habitat Expected to Provide Future Old Growth Forest Conditions	45	54	37	60	39	69	49

Issue 4 - Riparian Area Management, Water Quality, and Aquatic Habitats

What are the desired riparian ecosystem conditions within national forests, and how will they be delineated, maintained and/or restored? What management direction is needed to help ensure that the hydrologic conditions needed for the beneficial uses of water yielded by and flowing through National Forest System lands are attained? What management is needed for the maintenance, enhancement, or restoration of aquatic habitats?

Water is often referred to as our most precious resource. Although water supplies in the South are abundant, expanding urbanization and development are creating increased demands and impacts on the waters of the South. According to the Southern Appalachian Assessment, two-thirds of reported water quality impacts are due to nonpoint sources. Soil erosion and stream sedimentation—as well as nutrient, chemical, and bacterial contamination—can result directly or indirectly from land uses. Beneficial uses of water are often undesirably and unintentionally affected by water quality degradation created by land uses.

The Southern Appalachian Assessment also indicates that forestry has a low potential for impact on aquatic resources and that urban development and mining have caused the largest alterations in waters of the region. However, it also points out that the impacts on water are greatest for land uses and activities near streams. (Some examples of this include overused campsites, and lack of maintenance on roads and trails.) Water quality impacts also increase with the proportion of a watershed that is disturbed.

National forests were originally established, in part, to secure favorable water flows. The 1972 Clean Water Act requires states to establish water quality standards for streams and water bodies, including designation of beneficial uses, criteria to protect beneficial uses, and an antidegradation policy. The Forest Service must meet, or exceed, these State procedural and substantive requirements for water quality on the national forests. National forest management should protect the beneficial uses, namely coldwater or warmwater fisheries, recreation and municipal water supplies, habitats for other indigenous aquatic life, and aquatic TES species.

Some people have expressed concern about national forest management effects on water quality. Some are concerned about the effects of timber harvesting, recreational uses, and road building on water and in-stream habitats. Streamside protection measures, harvesting practices, in-stream habitat management and water quality monitoring methods in existing Forest Plans need to be reevaluated. There are also concerns about off-forest effects on the water quality and aquatic habitats within the national forests. In some cases, water quality and aquatic habitat protection and improvement will require the support and cooperation of other publics, industry, or neighbors within a watershed, depending on the prevalent land uses.

The maintenance and/or enhancement of aquatic habitats are also necessary to maintain healthy viable populations of fish, mussels, and amphibians. The protection of aquatic habitats for threatened, endangered, sensitive, game and non-game species is necessary for the survival of these species. The desired conditions for aquatic habitats should also consider the conditions necessary to increase recreational fishing opportunities.

Riparian areas have value to many users for a variety of purposes. Habitats for a multitude of plant and animal species and most of the highest valued recreation sites reside in the riparian zone. Riparian areas are often the most productive sites for growing high-quality wood products. Competition for this “rich” resource is strong, making the

COMPARISON OF ALTERNATIVES

issue an important one to almost every user group, visitor, and manager. This issue also relates to an area that was emphasized in the 1995 Draft RPA.

ISSUE 4 RIPARIAN

The riparian and forestwide standards provide full protection for water quality in all of the alternatives. Every alternative considered in detail includes standards and best management practices to ensure recreation, timber, minerals, grazing, and other uses are regulated and controlled to protect the quality of the water flowing from the JNF.

Alternatives A, B, D, E, G, and I take this a step further to protect the riparian forests along our streams, lakes, rivers, and wetlands. New *state of the art* standards are employed to protect perennial, intermittent, and ephemeral stream channels. The riparian corridor is designed to not only maintain water quality and protect aquatic species, but to also maintain the actual riparian area and the terrestrial species who use this area.

Alternatives A, B, D, E, G, and I set aside source (or municipal) watersheds for special management to protect drinking water. These same alternatives identify watersheds in need of restoration and use reference watersheds to help identify when a watershed needs restored. Between the Draft and Final EIS, The Forest worked closely with the U.S. Fish and Wildlife Service to develop a Fish and Mussel Conservation Plan that has been incorporated into Alternative I. New aquatic habitat areas were also designated as a result of these efforts. Table 2-6 shows the comparison between alternatives related to this issue.

Table 2-6. Comparison of Issue 4 (Riparian, Water Quality and Aquatic Habitat) by Alternative

	Alternative						
	A	**B**	**D**	**E**	**F**	**G**	**I**
Soils	Acres In Thousands						
Short- and Long-Term Effects to Soil Productivity (first decade)	4.7	3.4	5.4	3.7	5.1	1.4	4.5
Water	Percent Increase						
Average Percent Increase in Sediment Yields from Forest Service Activities over Current Levels Across 36 Watersheds	0.44	0.34	0.80	0.18	0.47	0.07	0.47
	Acres In Thousands						
Acres Allocated to Watershed Emphasis Prescriptions (9A1, 9A2, 9A3, 9A4)	28.2	38.0	24.1	22.8	0	27.3	27.4
Aquatic Species Viability	Number of Species/Number of Watersheds						
Low Risk	13/13	13/13	15/15	13/13	13/13	13/13	13/13
Moderate Risk, FS May Positively Influence	4/5	4/5	6/8	4/5	4/5	4/5	4/5
Potential High Risk, Little Opportunity for FS Influence	88/180	88/180	96/198	88/180	88/180	88/180	88/180
Potential High Risk, FS May Positively Influence	0/0	0/0	0/0	0/0	0/0	0/0	0/0
Potential Very High Risk, Little Opportunity for FS Influence	1/2	1/2	1/2	1/2	1/2	1/2	1/2

Issue 5 – Wood Products

The issue surrounding the sustained yield production of wood products from national forests has several facets, including (1) What are the appropriate objectives for wood product management; (2) Where should removal of wood products occur, given that this production is part of a set of multiple use objectives, and considering cost effectiveness; (3) What should be the level of outputs of wood products; and (4) What management activities associated with the production of wood product are appropriate?

Some people express a strong feeling that national forests are public lands that should be set aside, either for providing forest-related values other than timber, or as a reserve of timber. Others have similarly strong views of the purpose of national forests as primarily a support for local or regional wood processing facilities and their contribution to the local economies; as a place where there should be an emphasis on utilizing the current forest growth capabilities; or as a place where there is a community-based balance between wood production and recreation benefits. Still others see that the values they are concerned with, such as wildlife game species, can be best provided through habitat manipulation that includes the production of wood products. With recent policy changes of the Forest Service toward more ecology-based management, some people question whether the wood product role of national forests has changed. Others point out that the national forests still need to be managed to provide for multiple uses, including wood products.

Table 2-7 compares the differences between alternatives related to timber management. Alternatives D and F have the highest amount of lands suitable for timber production and the highest Allowable Sale Quantity or ASQ. Alternative D comes closest to meeting demand for wood products from the JNF. Alternatives A, E, G, and I specifically emphasize the high quality sawtimber market, with Alternative A meeting more of this demand than the other alternatives. Alternatives B, E, and G only produce wood products as a result of meeting other resource objectives. The majority of Alternative I focuses on these other resource objectives as well, but does allocate 16,200 acres to management prescription 10B which does emphasize high quality forest products.

Table 2-7. Comparison of Issue 5 (Wood Products) by Alternative

	Alternative						
	A	B	D	E	F	G	I
Age Class Distribution in 2030	Percent of Forested Acres						
0-10 (1% in 2000)	3	3	6	<1	3	<1	2
11-40 (9% in 2000)	6	5	10	2	7	2	5
41-80 (40% in 2000)	9	9	9	10	9	10	10
81-100 (31% in 2000)	15	16	15	16	15	16	15
101-130 (15% in 2000)	52	52	46	55	51	55	52
131-150 (3% in 2000)	8	8	7	9	8	9	9
150+ (1% in 2000)	7	7	7	8	7	8	7
Timber Management	Acres In Thousands						
Lands Suitable for Timber Production	278	250	303	189	303	125	259
	MMBF						
Allowable Sale Quantity (Total First Decade)	265	233	502	55	272	34	212
Timber Sale Program Quantity (Total First Decade)	278	233	502	77	272	38	218
	Percent of Current Annual Demand						
Timber Sale Program Quantity as a Percent of Demand	41	34	74	11	40	6	32

COMPARISON OF ALTERNATIVES

ISSUE 6 SCENERY

ISSUE 7 RECREATION

Issue 6 - Aesthetics/Scenery Management

What scenic integrity should the national forests have in the future, and what scenic opportunities should they provide?

Some people pointed out that natural-appearing landscapes of high-quality scenery are one of the main reasons tourists and recreationists come to the Southern Appalachians. Some think that a predominantly natural-appearing, nonindustrial-looking forest landscape character should be emphasized; and that certain areas of the national forests–such as travel and trail corridors, important viewsheds, and other places with recreation use–should provide a higher level of scenery. Some people also commented that management for hardwoods should be increased because hardwoods tend to enhance the scenic quality of an area. Others mentioned that while harvesting wood products does tend to cause a visual disruption, this effect is only temporary and that the harvest method used should be whatever is needed to meet resource objectives. Some commented that scenic quality could be restored through the use of salvage timber harvesting following disturbances like fires and insect outbreaks. Others said that the Forest Service should identify and implement methods that will reduce the visual impact of timber harvest so that harvesting can continue to be used as a management tool.

As a result of implementing the new Scenery Management System Alternatives A, B, D, E, G, and I all have much higher objectives for scenery than the 1985 Jefferson Forest Plan (Alternative F). This is primarily a result of recognizing that backcountry landscapes are highly valued even though they are not viewed as frequently as the foreground along major roads and trails. Under the old Visual Management System, these backcountry areas would frequently have low or very low objectives for managing scenic integrity. Under the new System, these areas are managed with high or very high scenic integrity objectives. It follows, therefore, that the Alternatives with the highest acres of recommended wilderness study and backcountry recreation have the highest scenic integrity objectives. Table 2-8 compares scenic integrity objectives by alternative.

Table 2-8. Comparison of Issue 6 (Scenery Management) by Alternative

	Alternative						
	A	B	D	E	F	G	I
Scenery	Percent of Total Forest Acres						
Scenic Integrity Objective Very High	12	12	11	20	8	32	14
Scenic Integrity Objective High	37	39	29	53	8	34	38
Scenic Integrity Objective Moderate	41	34	40	25	27	26	34
Scenic Integrity Objective Low	10	15	20	2	49	8	14
Scenic Integrity Objective Very Low					8		

Issue 7 - Recreation Opportunities/Experiences

How should the increasing demand for recreational opportunities and experiences be addressed on the national forests while protecting forest resources? This includes considering a full range of opportunities for developed and dispersed recreation activities (including such things as nature study, hunting and fishing activities, and trail uses.)

People are using trails today for much more than backpacking. Mountain biking, horseback riding, and off-highway vehicles are all used on national forest trails. Due to the limited sources of supply, these trails are often congested and have become sources of conflict between users. In many cases, there is a strong interest in increasing the trail networks for all these uses. Increases in the trail miles would increase trail use opportunities and reduce the congestion on existing trails. The challenge would be with developing a trail system that recognizes conflicting uses and minimizes resource damage. Of particular concern is a policy for managing OHV use. Trails of national interest and trail systems that connect adjacent national forests (e.g., the Appalachian Trail) need to have coordinated management direction.

Comments were made that the Forest Service should emphasize providing for recreational opportunities that are not generally available on private land. Other comments have been made to the effect that before the Forest Service builds new facilities, there should be an emphasis on maintaining and upgrading the existing facilities.

Table 2-9 compares recreation opportunity spectrum, developed recreation capacity, and trail miles across alternatives. Alternatives E, G, and I ensure protection of semi-primitive areas through a buffer zone designated semi-primitive 2. Alternatives A, E, and I have the highest levels of developed and motorized recreation, while Alternative G emphasizes non-motorized recreation opportunities.

Table 2-9. Comparison of Issue 7 (Recreation) by Alternative

	Alternative						
	A	B	D	E	F	G	I
Adopted Recreation Opportunity Spectrum	Acres In Thousands						
Semi-Primitive Non-Motorized	117.3	117.3	117.3	117.3	89.7	117.3	117.3
Semi-Primitive Motorized	20.7	20.7	20.7	20.7	72.5	20.7	20.7
Semi-Primitive 2	0.0	0.0	0.0	98.8	0.0	98.8	98.8
Roaded Natural	580.7	580.7	580.7	481.9	556.5	481.9	481.9
Rural	4.6	4.6	4.6	4.6	4.6	4.6	4.6
Developed Recreation	Percent Increase						
Estimated Increase in Capacity of Developed Recreation Areas	6-25%	<5%	<5%	6-25%	7852 PAOT[1]	<5%	6-25%
Estimated Increase in Non-Motorized Trails	6-25%	<5%	<5%	6-25%	1,125 Mile[1]	<5%	6-25%
Off-Highway Vehicle Roads and Trails	Miles						
Estimated Increase in OHV Miles in Designated Areas	60			30			30-60
	Percent Increase						
Estimated Increase in Motorized Roads and Trails	>51%	Decrease	11-50%	11-50%	100 Mile[1]	Decrease	11-50%

[1] Existing Inventory; PAOT is Persons At One Time

COMPARISON OF ALTERNATIVES

ISSUE 8 ROADLESS AND WILDERNESS

Issue 8 - Roadless Areas and Wilderness Management

What National Forest System lands should any be recommended for wilderness designation? For any roadless areas not recommended for wilderness, how should they be managed? How should areas recommended for wilderness designation be managed? How should the patterns and intensity of use, fire, and insects and disease be managed in the existing wilderness areas?

The sufficiency of the existing wilderness areas continues to be debated. A wide spectrum of feelings and values for more, less, or the same exists among the national forests community of interests. people have indicated that all roadless areas should be recommended for wilderness designation, while others have expressed that there is enough wilderness already and that the roadless areas should be managed to achieve other resource objectives.

People have expressed concern over the fate of any roadless areas not recommended for wilderness. Some have proposed that these areas be used to mitigate habitat fragmentation, or managed as scenic areas, or managed to provide a “remote” or “semi-primitive non-motorized” recreation experience. Others feel that an area does not have to be labeled as “roadless” or “wilderness” in order to provide biological diversity. They feel that in order to provide high-quality wildlife habitat, different types of disturbances are needed in order to create a variety of successional stages. Others would like to see the lands in roadless areas available for timber production.

Comments were received that even if certain areas do not meet the criteria for inclusion in the roadless area inventory, these areas should still be considered for inclusion in the wilderness system. Other comments indicated that the Forest Service should consider decommissioning roads within Forest Service jurisdiction in order to “create” areas that would then meet the criteria for inclusion in the roadless area inventory.

For areas that are already congressionally designated as wilderness, concerns have been expressed about how they are managed. The recommendation of any new areas to the wilderness system may also have an impact on how any existing wilderness areas that are nearby are managed. These wilderness management concerns include patterns and intensities of uses, insect and disease management, fire management including the use of more management prescribed fire, incorporating limits-of-acceptable change concepts into plan direction, and the mitigation of air pollution effects on wilderness resources. Existing wilderness standards need to be reviewed to see if they are effective in achieving the desired future conditions of wilderness resources.

Table 2-10 highlights the differences among the alternatives. In some cases, not all of an individual roadless area’s acres were allocated to the 1B (Recommended Wilderness Study) management prescription and therefore the acres may not be same across the alternatives for each roadless area. Also in several alternatives, recommendations for wilderness include areas that are not inventoried roadless.

Table 2-10. Comparison of Issue 8 (Roadless Areas and Wilderness) by Alternative

	Alternative						
	A	B	D	E	F	G	I
Wilderness / Roadless				Acres In Thousands			
Recommended Wilderness Study Areas	28.2	15.6	15.7	81.6		156.1	25.2
Roadless Character Maintained	82.6	87.1	41.6	148.4	68.8	148.4	148.4
				Miles			
Bicycle and Motorcycle Trails Closed in Recommended Wilderness Study Areas	19.5		8.7	61.3		124.3	5.9
Roads Closed in Recommended Wilderness Study Areas	5.7	6.0	3.4	31.3		61.0	7.7
Roadless Areas Recommended for Wilderness Study (1B)	**A**	**B**	**D**	**E**	**F**	**G**	**I**
Barbours Creek Addition						700	
Bear Creek				18,200		18,200	
Beartown Addition A	1,400	1,400		1,400		1,400	
Beartown Addition B		2,000		3,200		3,200	
Beaverdam Creek *(CNF)						1,100	
Broad Run						10,900	
Brush Mountain				5,900		5,900	
Brush Mountain East			4,900	3,400		4,900	
Brushy Mountain			4,100			4,100	
Garden Mountain				2,700		4,000	3,500
Hoop Hole	4,600		3,600			4,600	
Hunting Camp Little Wolf Creek	8,600	8,250		8,900		8,900	8,800
James River Addition	1,100					1,100	1,100
Kimberling Creek Addition A	50		100	100		100	50
Kimberling Creek Addition B	200		200	200		200	200
Lewis Fork Addition	700	300		300		700	
Little Dry Run Addition	2,200			2,200		2,200	
Little Horse Heaven						4,700	
Little Walker Mountain				9,800		9,800	
Little Wilson Creek Addition A	50	50	50	50		50	50
Little Wilson Creek Addition B	1,700	1,700		1,700		1,700	1,700
London Bridge Branch *(CNF)						900	
Long Spur						6,000	
Mottesheard						6,600	
Mountain Lake Addition A	900		1,200	1,500		1,500	900
Mountain Lake Addition B	3,900			3,900		3,900	2,200
Mountain Lake Addition C	500	500		500		500	500
North Fork Pound							
North Mountain						8,400	
Patterson Mountain						4,900	
Peters Mountain Addition A	1,300	1,300	1,300	1,100		1,600	1,300
Peters Mountain Addition B	900			2,700		2,900	
Price Mountain						9,100	
Raccoon Branch				4,400		4,400	
Rogers Ridge *(CNF)			150	150		150	
Seng Mountain				6,400		6,400	
Shawvers Run Addition				1,000		1,900	1,200
Other Areas Recommended for Wilderness Study (1B)	**A**	**B**	**D**	**E**	**F**	**G**	**I**
	100	100	100	1,900		8,200	3,700

*(CNF) These areas are shared with the Cherokee National Forest

COMPARISON OF ALTERNATIVES

ISSUE 9
FOREST HEALTH

Issue 9 - Forest Health

What conditions are needed to maintain forest capacity to persist and perform as expected or desired? Of particular concern are the impacts of non-native invasive species; and the presence of ecological conditions with a higher level of insect and disease susceptibility.

A healthy, resilient forest includes clean water, clean air, fertile soils, and abundant fish and wildlife populations. By the same token, healthy forest vegetation determine the health of our watersheds and soils, our riparian and aquatic ecosystems, the quality of habitat for wildlife, the ability of our national forest to filter our air and provide beautiful scenery, bountiful recreation opportunities, and essential wood products.

Many aspects of this issue are covered under Issues #1, 2, 3, 4, 10, 15, and 20. The remaining aspects to cover include restoration and maintenance of our native forest communities, non-native invasive species and insect and disease problems.

Although many forest communities on the JNF did not have a frequent fire return interval, those that did are suffering from serious forest health issues today due to the successful fire suppression policies of the past. All alternatives analyzed in detail increase the use of prescribed and wildland fire compared to the 1985 Forest Plan (Alternative F). Fire is important to restore the open, savannah-like, woodlands now largely missing from the landscape due to fire suppression, along with the southern yellow pine communities that dominated the dry ridgetops and southern aspects of the Forest. Table 2-11 displays acres of prescribed fire by alternative.

For those native and non-native insects and diseases that thrive in older aged forest conditions, Alternatives A, D, and F maintain more of the JNF in younger age classes than the other alternatives. All alternatives recognize the serious threat to forest health from non-native invasive species and seek to identify, slow the spread, suppress, and eradicate these unwelcome invaders to the extent possible. Table 2-10 compares gypsy moth risk rating by alternative and how the different alternatives maintain and restore forest communities through several management prescriptions.

Table 2-11. Comparison of Issue 9 (Forest Health) by Alternative

	Alternative						
	A	B	D	E	F	G	I
Gypsy Moth Risk Rating	Percent of Oak and Oak-Pine Forests						
Extreme Risk First Decade	26	27	26	27	26	27	26
Extreme Risk Fifth Decade	24	27	19	27	25	27	27
High Risk First Decade	36	37	36	36	36	36	43
High Risk Fifth Decade	43	46	41	44	43	44	45
Prescribed Fire	Acres In Thousands						
Maximum Burned per Year	14.1	19.3	14.9	9.4	2.9	15.7	15
Maintenance and Restoration of Forest Communities	Acres in Thousands						
Acres Allocated to a Forest Health Emphasis (9G1, and 9H)	0.1	121.3	114.5	0.1	0	10.4	25.0

Issue 10 - Special Areas and Rare Communities

What special areas should be designated, and how should they be managed? How should rare communities, such as those identified in the Southern Appalachian Assessment, be managed?

The current plan identified several types of "special areas," which are areas the Forest Service has the authority to administratively designate. Areas can be designated for special or unique aesthetic, archaeologic, biologic, geologic, historic, paleontologic, scientific resource values; or areas can be designated that provide unique and exceptional recreation experiences.

Rare communities are assemblages of plants and animals that occupy a small portion of the landscape, but contribute significantly to plant and animal diversity. They generally are characterized by relatively discrete boundaries and are small in area. Rare communities are frequently associated with areas of unusual geology or hydrology. Because of their importance to biological diversity and the small area affected, maintenance and restoration of these areas, as well as inventory and monitoring are a high priority under all alternatives. Special biological areas containing rare species have also been protected under all alternatives.

Table 2-12 displays special area designations by alternative. All rare communities are protected under all alternatives. Differences in acres shown in Table 2-12 are due to the fact that rare communities may be allocated to another management prescription like backcountry recreation or recommended wilderness study that will equally protect them. This is also the case for some other special area designations as well.

Table 2-12. Comparison of Issue 10 (Special Areas and Rare Communities) by Alternative

Special Area Designations	Alternative						
	A	B	D	E	F	G	I
	(thousands of acres)						
Research Natural Areas (4B2)	0	2.1	0	0	0	2.1	0
Special Geologic Areas (4C1 & 4C2)	13.3	0	1.1	12.5	0	0	1.5
Special Biological Areas (4D)	5.3	6.0	4.9	4.0	0.7	4.8	4.7
Special Cultural Heritage Areas (4E1a & 4E1b)	7.2	0.2	0.2	1.5	1.1	0.2	1.7
Scenic Areas (4F)	4.9	1.8	2.8	41.8	16.1	0.2	1.0
Other Special Areas (4K)	0	0	0	0	0	0	29.5
Rare Communities (9F)	6.3	10.0	8.5	5.3	0	8.4	7.4
Total Acres of Special Designations	37.0	20.1	17.5	65.1	17.9	15.7	45.8

Issue 11 - Wild and Scenic Rivers

The designation of wild and scenic rivers (W&SR) is a multistage process. "Eligibility" is determined through an inventory of streams and rivers that have outstandingly remarkable values (ORVs). Eligible streams then are classified as wild, scenic, or recreational. Next, "suitability" studies of the streams are accomplished to determine which streams can be recommended to Congress for possible designation.

The outstandingly remarkable values of all eligible wild and scenic rivers are protected

COMPARISON OF ALTERNATIVES

ISSUE 11 WILD AND SCENIC RIVERS

under all Alternatives, with the exception of F (1985 Forest Plan). None of these eligible rivers have been evaluated for their suitability for designation as part of the National Wild and Scenic Rivers System. Almost all of them contain some private lands that will require coordination with Virginia Department of Conservation and Recreation (VA-DCR) as well as private landowners. VA-DCR will likely take the lead on several of these rivers. Those that are predominately within Forest Service jurisdiction will be evaluated within the planning period.

ISSUE 12 ACCESS AND ROAD MANAGEMENT

Issue 12 - Access and Road Management

System roads are the primary means of national forest access; however, they are also a source of many concerns. These concerns predominantly center on the environmental effects of roads (which will be addressed in other issues, such as riparian, threatened and endangered species, etc.)

Some people would like to see the motorized access to the national forests increased, especially during hunting seasons for big game, for other recreational uses, or to meet forest management needs. Other people, however, feel that road construction should be limited and some existing roads decommissioned. Other comments were made that new roads should not be constructed for the purposes of logging or for OHV use. The amount of motorized access will need to be balanced with wildlife habitat needs, the need to provide both motorized and non-motorized recreational opportunities, the need to protect the soil and water resources, and the need to have management access.

By and large the road system of the JNF is complete, but there are still occasional needs for new roads to access trailheads, manage vegetation, or facilitate mineral development. These new roads are offset somewhat by decommissioning other roads that are no longer needed. Standards for road construction and maintenance are specified to ensure that water quality and wildlife habitat are protected under all Alternatives. Table 2-13 displays road construction, reconstruction, and decommissioning by alternative.

Table 2-13. Comparison of Issue 12 (Access and Road Management) by Alternative

	Alternative						
	A	**B**	**D**	**E**	**F**	**G**	**I**
Transportation System	Acres In Thousands						
Construction and Reconstruction Prohibited	154.6	157.2	101.5	225.5	128.7	245.8	209.2
Construction Prohibited, Limited Reconstruction	14.7	14.1	17.9	17.2	77.4	18.7	22.4
Limited Construction and Reconstruction	172.6	172.3	106.1	237.3	71.6	180.7	126.8
Construction and Reconstruction Allowed, No increase in Open Road Density	155.4	203.7	73.1	79.0	157.0	203.0	206.9
Construction and Reconstruction Allowed	226.0	176.0	424.7	164.3	288.6	75.1	158.0

A forest-wide Roads Analysis, completed for the Jefferson National Forest in January 2003. Roads analysis is an on-going process. The transportation inventory is continually updated as roads are constructed, reconstructed, relocated, reclassified, or decommissioned. In sensitive areas, decisions related to roads will be informed by watershed-scale or project-scale roads analysis. Roads analysis will be conducted concurrently with watershed analysis in priority watersheds. The Forest Supervisor or District Ranger may also decide to perform a watershed-scale or project-scale roads analysis in other areas based on site-specific conditions or issues.

Issue 13 - Minerals

How will the mineral resources of the National Forests be managed considering public demand for a wide variety of minerals? What areas will be made available for the exploration and development of federal leasable minerals and mineral materials.

The use of mineral resources is essential to the local, regional and national economy as well as to the public use, management, and sustainability of the National Forest. Congress has passed various laws providing for the exploration and development of mineral resources, including oil and gas, on National Forest System lands. Federal mineral resources are divided into two categories: 1) leasable minerals and 2) mineral materials. Leasable minerals are managed in cooperation with the U.S. Department of Interior Bureau of Land Management (BLM), and include oil, gas, coal, metallic minerals, and other hardrock leasable minerals. Mineral materials are managed by the USDA Forest Service, and include road aggregate, landscaping rock, rip-rap, and other earthen construction materials. Mineral materials are used to build and maintain trails, roads, campgrounds; to control erosion and sedimentation; to restore riparian and aquatic habitat; to repair flood damage; etc.

The 1987 Onshore Oil and Gas Leasing Reform Act indicates two decisions to be made regarding leasing of federally-owned oil and gas resources: 1) What lands are administratively available for oil and gas leasing and under what conditions or stipulations, and 2) What specific lands does the Forest Service authorize the BLM to offer for oil and gas leasing. The BLM, in turn, issues an invitation for competitive bid on these lands. This invitation may or may not result in an actual lease, depending on interest.

Table 2-14. Comparison of Issue 13 (Minerals) by Alternative

	Alternative						
	A	B	D	E	F	G	I
Federal Oil and Gas Leasing Availability and Consent Decision	Acres In Thousands						
Congressionally Withdrawn (No Consent)	55.7	55.7	55.7	55.7	55.7	55.7	55.7
Administratively Unavailable (No Consent)	32.5	27.1	24.7	82.4	0.0	157.8	44.6
Available/Consent with No Surface Occupancy Stipulation	101.1	102.0	67.2	133.2	0.0	63.0	195.9
Available/Consent with Additional Stipulations like Controlled Surface Use	253.0	231.9	181.7	252.1	0.0	196.7	140.5
Available/Consent with Standard Stipulations	186.4	212.0	299.4	105.3	573.0	155.5	192.0
Other Federal Leasable Minerals Availability	Acres In Thousands						
Congressionally Withdrawn	55.7	55.7	55.7	55.7	55.7	55.7	55.7
Administratively Unavailable	70.6	67.8	63.9	117.8	0.0	195.4	81.2
Available on a Case-by-Case Basis	333.4	293.2	209.7	321.3	0.0	221.7	282.0
Available	169.0	212.0	299.4	133.9	573.0	155.9	209.8
Federal Mineral Materials Availability	Acres In Thousands						
Unavailable for Commercial, Personal, and Free Uses	231.8	302.2	191.9	286.1	58.2	392.2	250.6
Unavailable for Commercial and Personal Uses, Available for Free Use	71.2	77.1	83.9	103.5	0.0	76.6	102.2
Available for Commercial, Personal, and Free Use	420.3	344.0	447.5	333.7	665.1	254.5	370.5

COMPARISON OF ALTERNATIVES

ISSUE 13 MINERALS

ISSUE 14 SPECIAL USES

The federal government owns the rights to all minerals on about 88 percent of the Forest acreage. Mineral rights on the remaining 12 percent of the Forest acreage are privately owned (See Issue #17).

Some people have expressed that oil and gas leasing and mining are inappropriate activities on National Forest lands. They are particularly concerned about the effects of these activities on water quality and other resource values. Other people asked that mining and leasing activities not occur in sensitive areas like riparian zones, key recreation areas, and old growth areas. Some people recommended that stipulations of "no surface occupancy" apply to all or part of the Forest and several people noted that the Plan needs to consider opportunities for leasing of various minerals important to society.

Mineral leasing and availability by alternative are displayed in Table 2-14. Aside from standard and additional stipulations and Federal laws governing mining activities, all alternatives also have forestwide standards to minimize potential effects to other resources, while ensuring an efficient and effective mineral leasing process.

Issue 14 – Special Uses

How should the Forest Plan address special uses of the National Forest? The Forest Service receives many requests for special uses including linear rights-of-way, military exercises, electronic/communication sites and commercial services. Although the Forest planning process cannot predict with certainty the kinds and locations of these special use requests, an attempt has been made to determine what requests may occur and where such use can be appropriately integrated with other forest uses. Whether or not to permit such use is a site-specific project decision. The Forest Plan alternatives identify where there are any types of special uses that would not be compatible with achieving the desired conditions established for a particular area.

Some people desire a consistent approach to evaluating special use requests. Others feel many types of special uses are inappropriate on National Forest land and are concerned about effects on scenic quality, wildlife habitat, and recreation opportunities. Some people stated that uses should be concentrated to minimize effects across the Forest. Comments ranged from excluding all special use requests to those interested in seeking out opportunities for new or expanded uses.

Section 302 of the Federal Land Policy and Management Act of 1976 provides the Forest Service's authority to issue leases and permits for the use, occupancy, and development of the public lands. Authorizations for access through national forest to private land are special uses, as are military exercises and training, recreational activities such as outfitting & guiding and competitive events such as fishing tournaments, foot races, horse endurance races, and mountain bike races.

Table 2-15. Comparison of Issue 14 (Special Uses) by Alternative

	Alternative						
	A	B	D	E	F	G	I
Special Uses	Acres In Thousands						
Unsuitable for Linear R-O-W and Comm Sites	173.7	167.8	113.8	248.6	57.8	254.2	218.0
Unsuitable for Linear R-O-W	3.7	24.7	0	43.9	0	77.3	0
Restrict Linear R-O-W and Comm Sites	309.0	279.8	210.3	286.6	665.5	252.4	221.3
Suitable for Linear R-O-W and Comm Sites - See Forest-wide Standards	236.9	251.0	399.2	144.2	0	139.4	284.0

Suitability for linear rights-of-way and communications site designation are displayed by alternative in Table 2-15.

Issue 15 – Fire Management

How will fire be used in land management activities such as wildlife management, fuels management, silviculture, and ecosystem restoration and maintenance? What measures should be taken to minimize air pollution impacts from prescribed fire?

The current Forest Plan provides direction for fire suppression strategies along with prescribing fire for a variety reasons including silviculture, fuels treatment, and wildlife habitat improvement. The greater emphasis on ecosystem management has resulted in a need to consider prescribed fire for ecosystem restoration, enhancement and maintenance, particularly in fire-dependant or associate ecological communities and wilderness areas.

Controversy exists about the expanding role of fire as a tool to accomplish vegetation management, address forest health problems and to manage rare communities. Some would like to see the use of fire increased, particularly to reduce the risk of catastrophic wildfire, while others question the importance of fire's role in many Southern Appalachian ecosystems. Concern was expressed about smoke management and the effects of burning in riparian areas. On the Jefferson NF, controversy surrounds the use of prescribed burning to maintain pastureland and the balds on the Mount Rogers National Recreation Area.

The presence of fire on the JNF began long before humans arrived in North America. Evidence of lightning fires exists in coal layers and as lightning scars on petrified trees. Sedimentary records are one method of constructing fire histories in the east for pre-European settlement times. These studies typically extract a core of sediment from a pond or bog, and that core is then sampled for fossils and/ or charcoal. Another method, fire dendrochronology, was used on Brush Mountain on the New River Valley Ranger District.

Wildland fires historically burned every 7 to 12 years on dry ridgetops and south-facing slopes, creating an open woodland condition with older aged oaks and pines and a grassy or shrubby understory. This open, savannah-like, woodland is now largely missing from the landscape due to fire suppression and the subsequent ecological changes that favor species that flourish in shadier, fire-free conditions. Restoring and maintaining this open forest woodland that is now in decline provides important habitat conditions for supporting federally-listed threatened and endangered species such as Indiana bat and other high priority species in need of conservation attention such as Appalachian yellow-bellied sapsucker and golden-winged warbler.

In addition, table mountain pine, a fire-dependant species native to JNF, has serotinous cones that are sealed tight until the heat of a wildland fire opens the cone, releasing the seeds inside. Table mountain pine, pitch pine, and other native southern yellow pines are slowly being replaced on the landscapes of the Forest.

Table 2-16. Comparison of Issue 15 (Fire Management) by Alternative

	Alternative						
	A	B	D	E	F	G	I
Prescribed Fire	Acres In Thousands						
Maximum Burned per Year	14.1	19.3	14.9	9.4	2.9	15.7	15

COMPARISON OF ALTERNATIVES

ISSUE 15
FIRE

ISSUE 16
LOCAL COMMUNITIES

Although understanding historical and pre-European settlement conditions provides an important context for conservation planning, restoring such conditions is not an overriding objective or legal requirement for plan revision. In most cases, ecological and adjacent land use conditions have changed too much for this to be feasible, let alone desirable. Alternatives B and G plan the most acres of prescribed fire use. Table 2-16 compares levels of fire across all alternatives.

Issue 16 - The JNF Effect On Local Communities & People's Effect On JNF

What is the role of the Jefferson in supporting local communities in a changing economic environment? Can a balance be found between commodity-related jobs and tourism-based jobs and the amenity related values important to quality of life? How should the changing demographics, attitudes, and needs of people around the Jefferson National Forest be reflected in a changing mix of goods and services? How will management respond to the changes in population and social structures occurring within and adjacent to the national forest?

The Jefferson National Forest contributes to local communities in many different ways--through jobs, quality of life, and a sense of place. The people and social structures of these communities are changing as the urban/suburban population continues to grow and our society continues to move away from an agriculture and manufacturing based economy towards a technology and retail based economy. These changes have and will continue to affect national forest management.

The Jefferson National Forest's importance to community economies varies according to the size of the community, its proximity to the Forest, and the diversity of its economy. Typically, the residents of rural communities in close proximity to National Forest lands have used the Forest for both their livelihood and for recreation. The economic well-being of the local community has generally been involved in manufacturing and processing of resources.

The Forest Service has a rural economic development responsibility as part of the Department of Agriculture. Some comments emphasized the importance of the timber industry to local community base economies, while others noted the importance of the tourism industry and quality of life factors in building a strong economy. Sustainable community forestry was mentioned as one way we might accommodate both of these views. Some mentioned we should consider the impacts of our activities on adjacent

Table 2-17. Comparison of Issue 16 (Local Communities) by Alternative

	Alternative						
	A	B	D	E	F	G	I
Percent Change in Employment from Current	-9%	-9%	-2%	-11%	---	-14%	-7%
Percent Change in Labor Income from Current	-11%	-11%	-2%	-15%	---	-18%	-9%
Payments to States/Counties (millions of dollars)	2.3	2.2	3.2	1.6	2.7	1.4	2.1
Cumulative Decadal Present Net Values of Benefits and Costs (millions of dollars, 4% discount rate cumulative to midpoint of 5th decade)	$2,531	$2,228	$2,322	$2,431	$2,293	$2,211	$2,312

landowners and the impacts of adjacent landowners on national forest management.

Table 2-17 displays the results of the economic analysis for each alternative. Social effects on local quality of life are harder to measure. One person's definition of quality of life may directly conflict with someone else's. In our revision outreach efforts, we heard from a diverse set of constituents that the Jefferson NF is very important from personal, societal and spiritual perspectives. These quality of life measures can be related to many of the other issues presented in this Chapter and throughout the EIS.

Issue 17 – Subsurface Property Rights

How will subsurface property rights, reserved and outstanding, and mineral leases held by production be taken into consideration when looking at alternative land allocations?

Private mineral rights (reserved and outstanding) underlie about 12% of the Forest. Forest Plan regulations (36 CFR 219.22) require that outstanding and reserved mineral rights shall be recognized to the extent practicable in forest planning. Land allocation and management decisions made through the forest planning process can inadvertently affect the rights of these property owners if not taken into account. Some mineral leases are "held by production" meaning the lease is in effect for as long as a well is producing, or capable of producing, oil or gas.

Private property rights, in general, are important to the citizens living around the Jefferson National Forest. The subsurface aspect is important because areas colored in green on Forest Service maps give the appearance of public ownership when this is not entirely true. Subsurface property rights were considered when making any restrictive land allocations, particularly wilderness study recommendations. Management prescriptions, desired conditions, and standards acknowledge where private subsurface property rights exist and specify that restrictions are subject to valid rights and leases. Table 2-18 displays the potential for conflict by alternative.

Table 2-18. Comparison of Issue 17 (Subsurface Property Rights) by Alternative

	Alternative						
	A	B	D	E	F	G	I
	Acres In Thousands						
High Potential for Conflict	14.9	14.3	12.3	21.5	2.5	21.8	23.1
Moderate Potential for Conflict	49.1	42.8	31.4	52.8	0	45.8	36.8
Low Potential for Conflict	30.6	37.5	50.9	20.3	92.1	27.0	34.7

Issue 18 – Mount Rogers National Recreation Area

What mix of goods and services are appropriate on the Mount Rogers NRA considering the qualities of the area that established its special designation? How should the Crest Zone be managed?

The mix of goods and services on the NRA needs to be commensurate with the qualities of the area that established its special designation as a National Recreation Area. Concerns included timber harvest, roads, land acquisition, recreation development, economic development including tourism, trail use and management of the Crest Zone.

It was requested that management direction be reevaluated for openings or balds which are naturally occurring or historic. Livestock grazing and prescribed burning are currently used to maintain these open areas. There is disagreement over the desired future condition of these areas, whether they should continue to be maintained as open or

COMPARISON OF ALTERNATIVES

ISSUE 18 MOUNT ROGERS NRA

allowed to revert to forested cover.

Table 2-19 shows the allocation of management prescriptions used on the Mount Rogers National Recreation Area for each alternative. Alternatives B and G would both cease managing the high country of the NRA to maintain the high elevation open pastoral

Table 2-19. Comparison of Issue 18 (Mount Rogers NRA) by Alternative

Prescription	Alternative					
Code	A	B	D	E	G	I
0.B	0.5	0.5	0.5	0.5		0.5
1A	12.3	12.3	12.3	12.3	12.3	12.3
1B	4.7	2.0	0.2	15.5	22.6	2.1
2C3	4.0			1.2	1.5	1.2
4A	11.8	13.7	14.7	11.7	11.6	6.4
4B2		0.4			0.4	
4C1	0.9		0.8	0.8		0.8
4D	0.5	0.5	0.5	0.5	0.5	0.5
4E1a	<0.1	<0.1	<0.1	<0.1	<0.1	<0.1
4F	4.4	0.6	0.6	6.9		0.1
4K						14.2
5A	<0.1	<0.1	<0.1	<0.1	<0.1	<0.1
5B						<0.1
5.C						0.1
6A	0.6	1.0	0.4	0.6	2.9	0.2
6B	0.4	0.1	0.1	0.5	1.9	0.2
6C	1.8	22.4	4.7	5.1	33.7	3.3
7A	1.9		0.5	1.6		1.8
7B	38.8		1.4	36.6		11.5
7D	6.2	3.2	3.3	11.1	2.3	2.6
7E1	1.9			3.9		3.4
7E2	10.9		24.4	4.4		23.3
7G	6.3	0.6		3.6		3.6
8A1		23.0	2.5		0.1	7.1
8A2	3.7	2.3			15.2	
8C	2.2	8.5			7.9	20.4
8E1	2.5			1.8		2.2
8E5	<0.1	0.1	0.1	<0.1	0.1	
8E6		2.4			2.1	
9A1	4.8	4.8	4.8	4.8	4.8	
9A3	0.3	7.4	0.3	0.3	1.5	0.6
9B2		1.0				
9B3		7.4	8.9		10.7	
9F		1.1			1.1	
9H		23.0	4.7		0.1	3.3
10A			31.2			
10B	7.9		19.5	1.9		
10D			4.4			
12A				6.1	7.3	7.4
12B	11.5	2.5		9.1	0.2	11.7
Total	140.8	140.8	140.8	140.8	140.8	140.8

setting. Alternative I restores key areas of spruce-fir forest for the northern flying squirrel. Alternative F (current management) is not shown because no attempt was made to map the current Mount Rogers Management Plan.

Issue 19 – Lands - Priorities For Acquisition, Deposition, And Exchange

What are the priorities for land adjustments including acquisition, deposition, and exchange?

Many priorities for land adjustment are spelled out in existing federal law and regulation including consideration of manageability; economic development; recreation and scenic values; biological values including threatened, endangered and sensitive species habitat; existing and potential land uses; and mineral potential. The Revision should display how these priorities might affect the land adjustment plan for the forest.

All alternatives have similar land adjustment programs aimed at consolidating National Forest ownership. Priorities for land adjustment are primarily set through national direction and carried out as lands become available for acquisition or exchange. Although it is possible to rearrange priorities by alternative, in reality land adjustments are driven more by what opportunities become available than by priorities.

Issue 20 – Air Quality

How will the revised Forest Plan guide monitoring and mitigation of air pollution effects on forest resources and facilitate interaction with the regulatory community? How will Forest management prescriptions (desired conditions, goals, objectives, standards, guidelines and possible management practices) incorporate air pollution considerations?

Air pollution is having negative effects on the Jefferson National Forest. Sulfur compounds in the atmosphere are primarily responsible for the haze that obscures visibility. Sulfur compounds and sometimes nitrogen compounds cause acidification of headwater streams and can cause nutrients to leach out of soils. Ozone causes visible injury to plant leaves, and can also cause reduced plant growth. Because the pollutants originate from many sources over a wide geographic area, regional approaches to air pollution emission reductions are necessary to improve air quality and resource conditions. Under all Alternatives, the Forest will work cooperatively with air management agencies, Visibility Improvement State and Tribal Association of the Southeast (VISTAS), and other regional planning organizations in order to reduce air pollution impacts to resources on the Forest.

Table 2-20 displays increases in particulate matter emissions over current levels by alternative. The projected emissions from prescribed fires under all Alternatives are not expected to be a large contributor to total fine particulate matter mass nor exceed any of the fine particle National Ambient Air Quality Standard (NAAQS). Nevertheless, the Forest will work with state air quality regulators to develop emissions inventories and other information.

Table 2-20. Comparison of Issue 20 (Air Quality) by Alternative

	Alternative						
	A	B	D	E	F	G	I
Air	Percent Increase						
Maximum Percent Increase in $PM_{2.5}$ Emissions over Current Levels (first decade) from prescribed fire	4	6	4	2	–	5	4

CHANGES BETWEEN DRAFT AND FINAL

CHANGES BETWEEN DRAFT AND FINAL

Over 12,000 individual pieces of mail, including e-mail, were received on the DEISs and Proposed Revised Forest Plans across the Southern Appalachians. Many offered recommendations or requests for changes or improvements in the environmental analysis; identified changes or improvements to the alternatives; or suggested modifications to the goals, objectives, or standards. Comments received on the DEIS and accompanying Proposed Revised Forest Plan also identified the need for several minor improvements to analysis and presentation of materials in the FEIS and Revised Forest Plan. As a result, editorial or other inconsistencies in the presentation of information in the DEIS were corrected for the FEIS.

Specific modifications to Alternative I and the environmental analysis beyond editorial and inconsistency corrections are explained in this section.

Water and Aquatic Species. Public comment on the Proposed Revised Forest Plan identified the management of water and aquatic resources as a key concern to a variety of people and organizations. This high level of concern resulted in re-examination of our riparian and watershed analyses and direction. In response to public comments and scientific peer review, the watershed health index was modified and renamed the watershed condition ranking. Watersheds with a low percentage of NFS ownership were changed from ‘not applicable’ to their actual rank. Ranking adjustment factors for riparian land use and riparian road density were eliminated. Watersheds with a below average watershed condition ranking were added to the list of priority watersheds in Chapter 2 of the Forest Plan. These watersheds will receive priority for watershed improvements, watershed analysis and roads analysis. Cumulative effects on aquatic species were reanalyzed using the new watershed condition ranking.

The riparian corridor desired condition and standards in management prescription 11 were revised based on coordination with the U.S. Fish and Wildlife Service, public comments, and interdisciplinary team field reviews. A clearer delineation between the actual riparian area (referred to as the core area) and the upslope filter strip were incorporated, allowing more management actions in the filter strip portion of the corridor to meet the desired condition of the adjacent management prescription, while maintaining full protection of the actual riparian area. Determination of the actual riparian area based on field conditions may result in site-specific adjustments to the riparian corridor to ensure the entire actual riparian area is protected without unnecessarily impacting our ability to achieve adjacent management prescription desired conditions. The formula used to calculate the filter strip on intermittent streams was replaced to be consistent with perennial streams resulting in easier application in the field.

Additional Aquatic Habitat Areas (management prescription 9A4) were added to the Forest Plan to provide additional protections for the James River spinymussel. Reference watersheds (9A2), inadvertently omitted from the Proposed Revised Forest Plan, were added to the management prescription map and management prescription 9A2 was added to Chapter 3 of the Final Forest Plan.

Objectives and standards related to determination and maintenance of instream flows needed to protect stream processes, aquatic and riparian habitats and communities, and recreation and aesthetic values were added to Chapter 2 of the Forest Plan.

Threatened, Endangered, Sensitive, and Locally Rare Species. Public comment and scientific review from Virginia Natural Heritage on the Proposed Revised Forest Plan identified the need to clearly depict where standards to protect the habitat of the Peaks of

Otter salamander applied. Areas of old growth communities (management prescriptions 6A, 6B, and 6C) and source water protection areas (management prescription 9A1) were changed within the primary Peaks of Otter salamander habitat conservation area to management prescription 8E2a. A map clearly showing both primary and secondary habitat conservation areas, as well as the management prescriptions assigned has been added to the 8E2 management prescription. The mineral leasing decision in the primary and secondary areas was changed to 'administratively unavailable.'

Minor changes were made to both the forestwide and management prescription standards for protection of the federally endangered Indiana bat as a result of consultation with the U.S. Fish and Wildlife Service (see Findings Related to Other Laws and Authorities below). A primary cave protection area for the Newberry-Bane cave located on private land in Bland County was added. The secondary cave protection area for Newberry-Bane is within the remote backcountry recreation area on Long Spur mountain. A secondary cave protection area for Patton Cave located on private land in Monroe County, WV was added. The cave is more than ½ mile from NFS ownership.

Species Viability. Aquatic species viability was reanalyzed for the FEIS as a result of public comment and scientific peer review. The watershed condition ranking change described above was used to address cumulative effects on aquatic species because it is the most likely source of impacts from management activities, correlates to changes in endemic aquatic species populations, and is the best available science. The relationship between sedimentation and locally adapted species was analyzed for the FEIS using data collected from Virginia streams for the Jefferson National Forest. This reanalysis did not result in any significant differences in aquatic viability species effects for any alternative including the Selected Alternative.

Minor adjustments were made to the terrestrial species viability analysis as a result of scientific peer review, review of effects by alternative, and modifications to Alternative I. F-ranks for individual species were adjusted through discussions with scientists familiar with species occurrences in Virginia and on the Jefferson National Forest. Abundance, distribution, likelihood of limitation, and management effects were adjusted as a result of a more thorough review of the effects by alternative and any modifications to Alternative I between the Draft and Final EIS. This reanalysis did result in minor differences in Alternatives B, E, and G, however the relative comparison of risk between alternatives did not change.

Wilderness Recommendations. Following issuance of the DEIS and Proposed Forest Plan, various communities of interest, County Boards of Supervisors, elected representatives, and State agencies wrote, called, e-mailed, and passed resolutions in support of or against specific wilderness study recommendations. Based on projected use in the area and given the development plans for Glen Alton, Peters Mountain Wilderness Addition B was changed from management prescription 1B to management prescription 12C, Backcountry Natural Processes.

Inventoried Roadless Areas. The acres of inventoried roadless areas was adjusted from 153,100 acres to 152,600 acres as a result of the AEP 765 kV transmission line decision.

Roads. A number of commenters requested we make changes to our forestwide Roads Analysis, open road density standards and objective for decommissioning roads in the Proposed Forest Plan. They correctly noted that in some cases our road density standards in the 1985 Forest Plan were more restrictive than those proposed in the Revised Forest Plan. The fragmented ownership pattern of the JNF means Forest Service System roads are an integral part of the rural transportation system and, conversely, State roads are an

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integral part of the Forest transportation system. Most of the roads on the Jefferson National Forest were originally constructed for access to recreation sites and for timber harvesting. Many were originally built by the Civilian Conservation Corps (CCC). Currently, these roads and their more recent counterparts serve a variety of needs including recreational access, fire protection, vegetation and wildlife management, adjacent private lands access, and energy and mineral development, to name a few.

Roads analysis is an on-going process. As a result of comments, we did revisit this analysis and the management direction related to roads in the Proposed Forest Plan. We strengthened the objective for road decommissioning. We revised many of our open road density standards.

High Quality Forest Products. Based on comments received on the DEIS, Alternative I has been modified to include 16,200 acres of the JNF specifically managed to produce high quality sawtimber.

Utility Corridors. The recent decision to authorize the 765 kV transmission line across approximately 11 miles of the JNF was incorporated into the Final Forest Plan and map. The point was raised during the comment period that our utility corridor management prescription included only existing utility rights-of-way without accommodation for co-location of new rights-of-way as described in the goal, desired condition, and standards for utility corridors. This oversight was corrected and ten of these corridors were expanded to 500 feet to allow for this accommodation. Conversely, those rights-of-way where we do not want to allow new uses or that we want to eventually decommission are not identified as utility corridors.

Other minor changes and corrections. A few other changes are worth noting. Additional field verification was made to our inventory of existing old growth forest communities resulting in some new areas being added and some areas dropped which were incorrectly identified. The special biological area around Dismal Creek was enlarged to include all significant elements of biodiversity. The map of lands suitable for timber production in the North Creek Special Area was in error and has been corrected. Areas of the Appalachian National Scenic Trail that were mapped incorrectly or shown as suitable for timber production in error have been corrected.

The mineral leasing decision acres have changed significantly between draft and final due to an error in calculation in the DEIS. Likewise, some of the figures related to the IMPLAN and FEAST models in the socio-economic section of the DEIS were also found to be in error and have changed significantly.

AFFECTED ENVIRONMENT AND ENVIRONMENTAL CONSEQUENCES

CHAPTER 3

INTRODUCTION

PHYSICAL ENVIRONMENT

DESCRIPTION OF ECOLOGICAL UNITS

INTRODUCTION

Chapter 3 describes the existing environment of the JNF (Jefferson National Forest) and the scientific and analytic basis for comparing the alternatives. Each section begins with a description of the affected environment including physical, biological, social, and economic characteristics. When available and relevant, a discussion of how the Jefferson fits into the broader context of the Southern Appalachians is also provided.

Environmental consequences related to the significant issues are discussed in the short- and long-term. Although a Forest Plan based on any alternative would guide management for 10 to 15 years, effects beyond the first decade also must be considered. This information helps reveal implications of implementing an alternative over the long-term. Sections not related to significant issues may not have an environmental consequences discussion (e.g. the Description of Ecological Units).

The chapter concludes by summarizing cumulative effects of the alternatives, describing irreversible and irretrievable commitments of resources, and unavoidable adverse effects.

PHYSICAL ENVIRONMENT

The physical environment is the non-living portion of the environment upon which the living organisms depend—air, soil, water, geology, and climate. This section begins with a description of the ecological classification of the JNF. Ecological classification is a system that classifies land and water at various scales through integrating information about climate, geology, landform, soils, water, and vegetation. This classification is a tool to provide a more ecological and scientific basis in land and resource management planning.

Ecological classification is useful for:

- Evaluating the inherent capability of land and water resources.
- Predicting changes occurring over time.
- Evaluating effects of management.
- Allocating land to management areas.
- Selecting appropriate management indicators.
- Discussing and analyzing ecosystems and biodiversity at multiple scales.

The reader will see this ecological classification referred to throughout this chapter. It provides an ecological context for the affected environment descriptions and a more specific and sensitive effects analysis.

DESCRIPTION OF ECOLOGICAL UNITS

The National Hierarchical Framework of Ecological Units is a classification and mapping system for dividing the Earth into progressively smaller areas of increasingly similar ecology. Ecological units are mapped based on patterns of climate, soils, air quality, hydrology, geology, landform and topography, potential natural communities and natural disturbances. These various components take on greater or lesser importance as the mapping scale changes. Conditions dominant at broad scales such as climate and geology are continually related to conditions at finer scales such as biologic communities and soil characteristics.

The JNF lies within the Central Appalachian Broadleaf Forest - Coniferous Forest - Meadow Province of the Humid Temperate Domain, Hot Continental Division. The New Castle and New River Valley Ranger Districts are entirely within the Northern Ridge and Valley Section (Ridge and Valley Subsection). The Smith Flats area of the Glenwood Ranger District and the Pond/Glade Mountains area of the Mount Rogers National Recreation Area (NRA) lie within the Great Valley Subsection of the Northern Ridge and Valley Section. The Blue Ridge Mountain Section contains the remainder of the Glenwood Ranger District (Northern Blue Ridge Mountains Subsection) and the Mount Rogers NRA (Southern Blue Ridge Mountains Subsection). The Clinch Ranger District lies within the Cumberland Mountains Section and spans 3 Subsections: Pine and Cumberland Mountain, Eastern Coalfields, and the Black Mountains Subsections. Figure 3-1 shows the Sections within the vicinity of the JNF.

The Jefferson National Forest has used Subsections as the primary scale for analysis in the forest plan revision process. Management Area delineations began with the Subsections and were then further broken down considering watersheds and other physical, biological, and social boundaries.

Northern Ridge and Valley Section (M221A)

Ridge and Valley Subsection (M221Aa), Great Valley Subsection (M221Ab)

The Ridge and Valley sections are characterized by long belts of parallel mountains and valleys, the landforms being closely related to the lithology and structure of the bedrock. The ridges consist of sandstone, shales, and siltstone with the occasional bands of limestone on the lower slopes. The valleys are composed of limestone, dolomite and shales. Agriculture and urban areas dominate the valleys, while forestry is the primary use

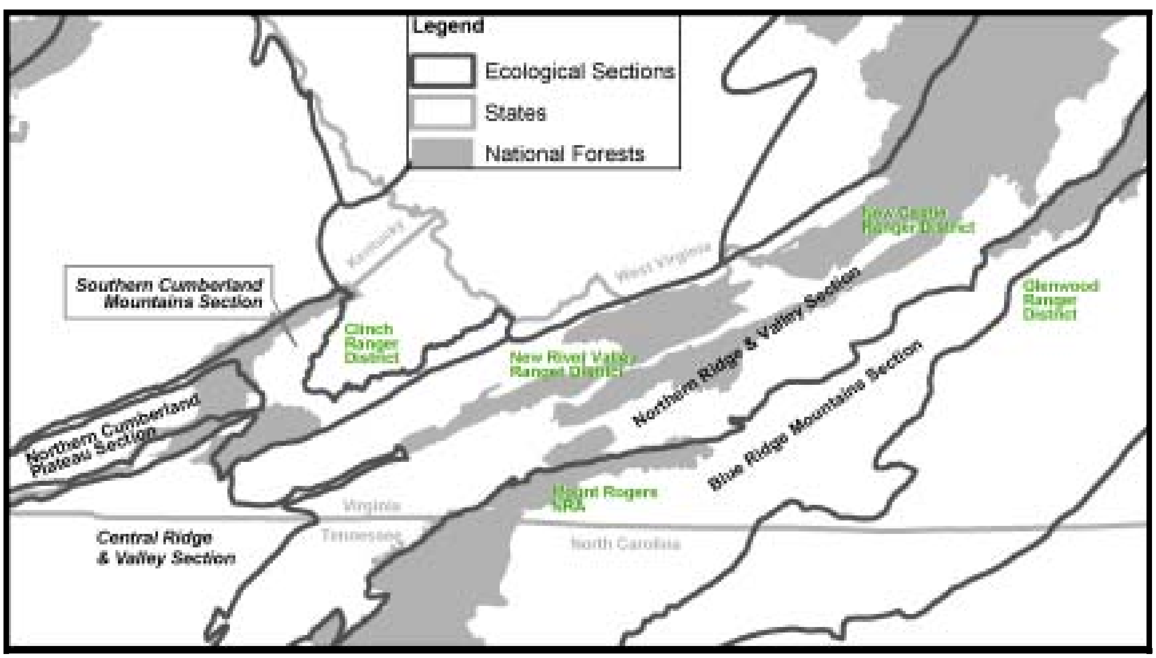

Figure 3-1. Ecological Sections of the Jefferson National Forest

on the oak-hickory covered ridges. These Appalachian oak-hickory and oak-pine forests were strongly influenced by fire prior to the 18th century.

Cumberland Mountains Section (M221C)

Pine and Cumberland Mountain Subsection (M221Ce), Eastern Coalfield Subsection (M221Cb), Black Mountains Subsection (M221Cc)

In southwest Virginia, in contrast to the Valley and Ridge Section, the rocks are nearly horizontal or gently dipping. The boundary between the sections, where it is sharp, is the Cumberland Escarpment. The Cumberland Mountain Section features faulted and folded monoclinal mountains comprised of Paleozoic sandstone and shale. The southern boundary area also has interspersed limestone. Geologically, this is the youngest area on the JNF and is characterized by Mississippian and Pennsylvanian bedrock geology. Forestry and mining are important land uses. These sections contain most of Virginia's coal and natural gas resources. Mixed mesophytic rich cove forests and dryer oak ridges dominate this area.

Blue Ridge Mountains Section (M221D)

Northern Blue Ridge Subsection (M221Da), Southern Blue Ridge Subsection (M221Dc)

The Blue Ridge Mountains Section is the oldest on the JNF. These tectonic uplifted mountain ranges are composed of Proterozoic-Paleozoic igneous and metamorphic rock, forming many high gradient, deeply incised streams. Extensive areas of metamorphosed sedimentary rocks occur on the western flank. Deeply weathered bedrock, called saprolite, occurs in some areas of the Blue Ridge. Mesic oak forests predominate, but large pockets of northern hardwoods and spruce-fir can also be found at the highest elevations. Ice, wind and fire are major natural disturbances throughout this section.

Direct, Indirect and Cumulative Effects

There are no environmental consequences (direct, indirect or cumulative effects) related to this section.

GEOLOGIC RESOURCES

The geologic setting is the foundation for a variety of ecologic elements. Geologic materials and geologic processes control or influence a host of ecological factors, such as slope aspect, slope steepness, the areal extent of landforms and associated vegetation, the distribution and composition of soil parent material, the structure and composition of vegetation, the physical character of wetlands, riparian area and stream substrates, the quantity and quality of stream water and ground water, and the natural disturbance regime.

Surface geologic processes are an important part of the natural disturbance regime in the Forest. These processes include: the erosion, transport and deposition of sediment; mass wasting or landsliding; flooding; changes in stream channels; groundwater flow; and the formation of caves, sinkholes and other karst features. These processes have always been part of the natural disturbance regime in the mountains and affect the Forest in varying degrees every year.

The interaction of the surface geologic processes with the different geologic formations and geologic structures produced different landforms. The Forest is subdivided into physiographic or geomorphic provinces based on landform, rock types and geologic structure.

VALLEY AND RIDGE GEOMORPHIC PROVINCE

Over half of the Forest is within the Valley and Ridge Geomorphic Province, which is a long belt of parallel mountain ridges and valleys. The Forest's ridges and valleys are long, linear landforms, trending in a northeast direction across westernmost Virginia.

Geologic forces squeezed the originally flat-lying sedimentary layers and folded them into a series of arches (anticlines) and troughs (synclines). Erosion of these folds over millions of years has produced a distinctive repeating landscape of ridges and valleys. Most of the JNF in this Province is located on strike ridges.

A strike ridge is a linear, asymmetric ridge formed by the differential erosion of inclined bedrock layers. One flank of the strike ridge is a steep slope cutting across several bedrock layers (antidip or scarp slope). In contrast, the other side of the ridge is a less steep slope conforming to the slope of the underlying bedrock layer (dip slope).

Resistant sandstone or conglomerate forms the top of strike ridges and much of the dip slopes. In contrast, the lower flanks of the ridges are underlain by shales, and in some places, carbonate bedrock (limestone and dolomite). The valleys are also underlain by shales and carbonate bedrock. In some limestone areas, caves, sinkholes, and other karst features have developed.

BLUE RIDGE MOUNTAINS GEOMORPHIC PROVINCE

The eastern portion of the Forest is located in the Blue Ridge Geomorphic Province, in which the northeast-trending Blue Ridge Mountains rise above the eastern border of the Valley and Ridge Geomorphic Province. Granite and other igneous rocks dominate the upper slopes of the Blue Ridge Mountains. Quartzites, sandstones, limestone and shales are found on many of the western slopes.

From Roanoke Gap northward, the Blue Ridge is a relatively narrow range of irregular mountain peaks. The Glenwood Ranger District is located in this part of the Blue Ridge. Extending south from Roanoke Gap, the Blue Ridge widens into a broad expanse of rolling plateau. Along the southwestern border of the plateau in Virginia, mountains rise above the plateau. The Mount Rogers NRA is located in this part of the Blue Ridge. The Mount Rogers NRA includes volcanic bedrock.

APPALACHIAN PLATEAU GEOMORPHIC PROVINCE

The southwestern portion of the Forest, including most of the Clinch Ranger District, is located in the Appalachian Plateau Geomorphic Province. Sandstone and shales are the dominant bedrock. A characteristic feature of this Geomorphic Province is that the underlying sedimentary bedrock layers are generally flat-lying or gently inclined. Erosion of the flat-lying strata carved this province's characteristic terrain: plateau uplands incised with a dendritic stream pattern. However, most of the Forest in this Province is located not on this incised plateau terrain, but rather on strike or monoclinal ridges (Pine Mountain, Stone Mountain and Powell Mountain), more characteristic of the Valley and Ridge Province.

GEOLOGIC RESOURCES

The Forest contains a diversity of geologic resources and special geologic features. Some examples are:

- Ancient giant landslides discovered on the Forest in the 1980s are the largest known in eastern North America. Some of the landslides contain more than one billion cubic meters of rock, and extend more than 5 kilometers along Sinking Creek Mountain.
- The Mt Rogers NRA contains remnants of volcanic explosions and lava flows, and glacial deposits from a 500-million year old Ice Age.
- The Forest includes part of the limestone karst terrain (caves, sinkholes, and disappearing streams), for which this part of Virginia is famous. The Raven Cliff Horse Camp area contains a variety of karst features including a disappearing stream, sinkholes, cave, resurgent stream, and a karst window to a subterranean stream. This collection of karst features is special because an excellent variety of karst features can be seen within a relatively compact area.
- The Forest includes the mountain rim of Burkes Garden, an oval-shaped valley, eroded from a great rock dome. This landform is unique in the Southern Appalachian region, and is visible from orbiting satellites.
- Waterfalls include the Cascades on the New River Valley District, Apple Orchard Falls on the Glenwood District, and the Falls of Little Stony on the Clinch District.
- Devil's Marbleyard, a huge, jumbled boulder field of quartzite, is remnant of a 500-million year old beach. Fossil remains in the form of ancient worm tubes, called scolithus, are abundant in many of the rocks.
- Boulderfields at the northeast end of Pine Mountain are an unusual landscape formed by extremely large blocks of sandstone that have broken off and moved downslope from the cliff. Pine Mountain itself is an unusually long strike ridge that extends for many miles along the Virginia-Kentucky border and then many miles into Kentucky.
- Fossils and paleontological resources include fossil plants, brachiopods, pelecypods, trilobites, ammonites, crinoids, worm bore holes, and ancient rippled-marked shorelines.

In recent years, the Forest has worked in partnership with the U.S. Geological Survey to develop interpretative and education brochures on the Forest's geologic resources. The Forest plans to continue development of interpretative sites and interpretative/ educational media relating to geologic resources.

GEOLOGIC HAZARDS

Forest Service planning regulations require evaluation of existing or potential watershed conditions that will influence hazardous events (36 CFR 219.23(e)). Geologic conditions are part of watershed conditions. Geologic hazards are geologic conditions or phenomena (naturally occurring or altered by humans) that present a risk or are a potential danger to life and property. The main geologic hazards for this Forest relate to flooding, landslides, landslide dams or woody debris dams, debris floods, waterfalls, abandoned mines, and karst hazards (sudden ground collapse, ground subsidence, sinkhole flooding, and groundwater pollution). Additional discussion on flooding is in the Water Resources section.

LANDSLIDES. Because the Forest's watersheds are mainly mountainous watersheds, landslides are an important natural disturbance that plays a major role in flooding, sedimentation, and the functioning of riparian areas. Landslides include a wide range of

PHYSICAL ENVIRONMENT

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mass movements such as debris avalanches, debris slides, debris flows, slumps, rockslides, stream channel bank failures, etc. In addition to natural landslides, some landslides (such as road cut slope failures) are caused or influenced by human activities. In order to place human-influenced landslides into context and to assess effects of human-influenced landslides, it is important to first understand the nature, scope, and effects of natural landslides in the Forest's watersheds. Infrequent storms with intense rainfall can trigger numerous landslides that drastically increase the destructive power of floods. In these landslide-dominated floods, the landslides can turn a lesser flood into a catastrophic flood by changing a water flood into a debris flood and by drastically increasing peak discharge with debris flow surges. These events are rare on any given stream, with recurrence intervals of more than 100 years in the Central Appalachian region (Hack and Goodlet 1960).

In terms of potential damage to facilities and resources on the Forest, and potential damage and injuries off the Forest, the most dangerous geologic hazards on the Forest are debris floods and landslides. Debris flows can also have a major effect on aquatic resources. Research in the Appalachian region (Jacobson et al. 1989) indicates that the most catastrophic of geomorphic events will be "those in which conditions simultaneously promote landslides and high flood discharges." Traditionally, after a storm the Forest generally does not detect or inventory landslides unless the storm has affected human activities or infrastructures.

One of the most common locations for landslides is alongside creeks and streams. As a result, all or most of the landslide debris at streamside locations is deposited directly into stream channels. Landslides add a large tonnage of sediment to the stream. In normal years, when there are no landslide-producing storm events, the annual sediment yield on the typical Forest watershed is estimated to be on the order of magnitude of tens of tons per square mile. In those infrequent years when storms produce multiple landslides on the Forest, the sediment yield from a single storm can be one to four orders of magnitude greater than the normal year. Storms sufficient to trigger landslides vary in severity and area extent. Depending on many factors (such as the number of landslides triggered), the sediment yield from a landslide-dominated storm can be hundreds, thousands, tens of thousands, or hundreds of thousands of tons per square mile. An example calculation of the enormous increases in sediment yields produced by a landslide-dominated storm in Virginia can be found in Williams, G.P. and Guy, H.P. (1973).

Landslides cause an increase in sediment yields for years, sometimes decades, after the landslide occurs. Roghair et al. (2002) conducted research on effects of the June 27, 1995 debris flow on fish in Staunton Creek in Shenandoah National Park, and reported that "In the area affected by the debris flow, the stream bed was scoured and new substrate materials were deposited, trees were removed from a 30-m-wide band in the riparian area, and all fish were eliminated…By June 1998, brook trout had recolonized the entire debris-flow-affected area, and population density exceeded previous levels." As indicated by this research as well as other research cited by Roghair et al. (2002), aquatic organisms typically can recolonize streams where debris flows destroyed existing habitat and fish populations, unless the new habitat is unsuitable. Roghair et al. (2002) also state that chronic disturbances (such as land use changes, global climatic changes, and acid rain) can have much more adverse effects on stream habitat and fish population persistence than catastrophic natural events like debris flows.

Management activities, such as road construction and timber harvest, may cause or contribute to causing landslides. But Forest-wide, the occurrence of landslides where roads, timber harvest, or other management activities is a contributing factor is uncommon. Existing roads and timber harvest areas are generally stable in regard to slope stability. Forest personnel travel various segments of the Forest road system on all Ranger

Districts every year, identifying road maintenance or reconstruction needs when encountered. These inspections have seldom identified road slope stability problems (cut-slope or fill-slope failures) as a major maintenance/reconstruction need. These inspections, many on roads decades old, indicate that Forest roads have generally good slope stability. Slides or slumps of road cut-slopes or fill-slopes have occurred occasionally on Forest roads, estimated on the order of 0-10 events per year. Slide volume has been typically in the range of 1 to 50 cubic yards, but during rare, intense rainfall events, some slide volume has been in the range of 100-500 cubic yards. Many of the road slides are slips or slumps in which most of the slide volume remains in the cut slope or fill slope.

DEBRIS FLOODS. A debris flood is a flood that incorporates, transports, and deposits so much solid material (such as landslide debris, valley fill, bedload, and/or large woody debris) that the solid material is a major component of the flood, drastically increasing the destructive power of the flood and the resulting flood damage. When infrequent, intense rains fall on the Forest and cause flooding, the mountain watersheds can add into the flood waters both inorganic (rocky debris) and organic (woody debris) materials that can increase the destructiveness of the flood on the Forest and off the Forest.

The role of landslides in creating debris floods was discussed in the Landslide section. The role of woody debris during floods is complex and sometimes contradictory. Large logs and whole trees in flood waters can act as battering rams, eroding the stream banks. This woody debris can form log jams and dams causing severe scour of the channel, mass failure of the stream bank, dam-induced flooding outside of stream channel banks, and debris flood surges due to dam failure. During floods, logs and trees are geologic agents of erosion, just as the flood waters, the suspended load, and the bedload are geologic agents of erosion. However, logs and trees are also normal components of the stream system. At lower stream flows they can provide stability to the stream channel, reduce the sediment load in streams and improve aquatic habitat. This increase in stability and sediment reduction can also allow the stream system to withstand higher stream flows. Stream channels that are capable of transporting higher flows under stable conditions can reduce the amount of rocky and woody debris that enters the system from eroding streambanks and adjacent landslides.

WATERFALLS. In terms of injuries to Forest visitors, waterfalls have been the most dangerous geologic hazard on the Forest. The slick rock, the strong current, the steep drop, and the hidden rocks in the pool beneath the waterfalls are natural hazards. Visitors who venture too close to, or play around in, the waterfalls have a risk of serious injury or death. Many serious injuries have occurred at Cascades Falls, including one fatality in 2002, and at the other waterfalls to which the Forest provides trail access. The Forest's waterfalls are featured recreation sites, highlighted in brochures for Forest visitors. Warning signs are used to inform visitors about the waterfall hazards.

KARST HAZARDS. Carbonate bedrock and associated karst features (caves, sinkholes, etc.) are found mainly in the valleys of the Valley and Ridge Province. The Forest is located primarily on the ridges of the Valley and Ridge Province. As a result, the Forest has only a few scattered areas of carbonate bedrock and associated karst features (caves, sinkholes, etc.). Potential karst hazards include 1) ground subsidence including sudden sinkhole collapse, 2) sinkhole flooding, and 3) groundwater pollution, including accidental spills of petroleum products.

ABANDONED MINES. The Forest has several hundred abandoned mine workings, primarily from historic mining of iron and manganese. Some abandoned workings, such as shafts or adits, are physical hazards, presenting risk of visitors falling or being hit by falling roof rock. The Forest has been reclaiming hazardous mine workings as funding allows. Some reclamation involves bat gates to provide bat habitat.

PHYSICAL ENVIRONMENT

Direct and Indirect Effects

GEOLOGIC RESOURCES

GEOLOGIC RESOURCES

The Alternatives vary by the number and acres of Special Geologic Areas designated under each Alternative, as follows: Alternative A-Sinking Creek Mountain (7,800 acres); Raven Cliff karst (800 acres); Boulderfields at northeast end of Pine Mountain (200 acres); Pine Mountain (4,000 acres); Alternative B-No Special Geologic Areas; Alternative D-Raven Cliff karst (800 acres); Alternative E-Raven Cliff karst (800 acres); Boulderfields at northeast end of Pine Mountain (200 acres); Pine Mountain (11,400 acres); Alternative F-No Special Geologic Areas; Alternative G-No Special Geologic Areas; Alternative I-Raven Cliff karst (800 acres), Boulderfields at northeast end of Pine Mountain (700 acres).

Regardless of which Special Geologic Areas are designated, the Alternatives have standards to protect the Forest's geologic resources, including caves, sinkholes, groundwater, volcanic features, glacial features, ancient giant landslides, waterfalls, fossils and paleontological resources, and unusual landforms like Dragon's Tooth. Standards under all Alternatives provide that the location and design of management activities will evaluate measures to avoid, minimize, or mitigate adverse effects on geologic resources with identified values (scientific, scenic, paleontological, ecological, recreational, drinking water). Management activities that involve earth-moving, such as road construction, have the most potential to affect geologic resources. The potential effects vary depending upon the type, size, and sensitivity of the resource, and the magnitude of the ground disturbance. Using earth-moving soil displacement as an indicator (Table 3-1), the ranking of the alternatives, descending from greatest to least potential impacts, are: Alternative D, F, A, I, B, E, and G.

Table 3-1. Acres of Ground Disturbance by Alternative for the First Decade

	Alternative						
	A	B	D	E	F	G	I
Acres of Ground Disturbance (1st Decade)	1,507	1,314	1,707	1,118	1,607	892	1,363

GEOLOGIC HAZARDS

LANDSLIDES. Management activities, such as roads, logging, trails, mineral exploration and development, and fire management, may cause or contribute to causing landslides. The construction and maintenance of roads, trails, log landings and other facilities may cause, or contribute to causing, landslides (mass movements) such as cut slope failures and fill slope failures. Some landslide material may reach stream channels and add to the sediment yield. During floods, some landslides caused by management activities may add destructive surges to the flood directly by swelling flood discharge with landslide debris (debris flows), or indirectly by swelling the flood discharge with the failure of landslide-created dams in the flooded channel. An excavation, such as a road excavated into a sidehill, undercuts the natural slope and reduces resistance to downslope movement of soil and bedrock. Sidecasting excess excavation onto a steep slope may result in an unstable mass of soil and rock prone to sliding on the natural slope. The construction and maintenance of roads and other facilities may alter the surface and subsurface drainage, and indirectly lead to slope failures beyond the area of construction. Timber harvest on steep slopes may also reduce slope stability and result in landslides. These are examples of management activities that can alter natural geologic conditions and may cause landslides (such as mass failure of the cut slopes or fill slopes), particularly during intense or prolonged rainstorms.

The potential for such impacts is reduced by Standards under all Alternatives that provide for geologic investigations of potential landslide hazards as part of the siting, design, and maintenance of roads and other management activities. Those Alternatives that have more disturbance, in terms of miles of road construction/ reconstruction and acres of timber harvested (acres treated), are estimated to have more potential to cause, or contribute to causing, landslides than those Alternatives with less disturbance. Using earth-moving ground disturbance as an indicator (Table 3-1), the ranking of the alternatives, descending from greatest to least potential impacts, are: Alternative D, F, A, I, B, E, and G. The acres of ground disturbance reflect such earth moving activities (road construction, mineral activities, etc.) and are based on the acres of long-term effects to soil productivity in Table 3-3.

Landslides caused by management activities have the potential to increase sediment yield. Road cut or fill slopes along creeks or at creek crossings may fail, and deposit all or most of road slope failure as sediment directly into a creek. The potential for such impacts is reduced by Riparian Standards common to all Alternatives that minimize new road construction in riparian areas and require designs. Most new roads would be constructed outside the riparian areas, in locations that generally are less subject to slope failure than riparian areas. In addition, because of road maintenance as well as distance from riparian areas, only a minor portion of road slope failures outside riparian areas would be washed away to be deposited as sediment in a creek. In contrast, many natural landslides commonly found on this Forest, such as debris slides, deliver the slide material directly into stream channels. Three common locations for natural landslides are: 1) the steep headwater chutes of mountain streams, 2) the steep inner gorges along mountain streams, and 3) the channel banks along valley streams.

A road slope failure may occur in any year after a road is built, including years with little rain. However, most road slope failures are likely to occur during years when natural landslides are also occurring in the same area. The infrequent, intense rainstorms that trigger road slope failures also trigger natural landslides. The number and size of road slope failures and natural landslides tend to increase with increasing quantity, intensity and duration of rainfall. As a result, those years when road slope failures are abundant are likely to be those years when the annual sediment yield due to natural landslides is higher than normal. The intense rainstorms that trigger natural landslides produce background sediment yield that range from 1 to 4 orders of magnitude higher than normal background. Normal background might be an annual sediment yield of tens of tons per square mile; the natural landslides from an intense storm could raise the sediment yield to hundreds, thousands, tens of thousands, or hundreds of thousands of tons per square mile. In such intense rainfall events, the management-caused or -influenced landslides are estimated to be a very small percentage of the total sediment for that event.

DEBRIS FLOODS. A debris flood is a flood that incorporates, transports, and deposits so much solid material (such as landslide debris, valley fill, bedload, and/or large woody debris) that the solid material is a major component of the flood, drastically increasing the destructive power of the flood and the resulting flood damage. The potential for management activities to cause landslides that can increase the rocky debris in floods, and thereby, increase the destructiveness of the floods is discussed under Landslides (above). The potential for management activities to increase the quantity of woody debris in stream channels, and thereby, increase the destructiveness of floods is discussed here.

The Riparian Prescription common to all Alternatives includes the objective: Streamsides are managed in a manner that restores and maintains amounts of large woody debris (LWD) sufficient to maintain habitat diversity for aquatic and riparian-dependant species (approximately 200 pieces per stream mile). Management activities that add large woody debris to streams to meet or exceed the objective have the potential to increase the destructiveness of floods due to the additional large woody debris incorporated in future floods. However this objective will be achieved primarily through passive management of riparian areas gradually restoring historic amounts and distributions of large woody debris. A standard to allow removal of large woody debris "when it poses a threat to private property or Forest Service infrastructure" (Standard 11-006) is common to all alternatives and addresses this concern, particularly in the event of an increase in woody debris from events such as windstorms or insect infestations.

It is projected that 30-50 stream miles per decade would be actively treated by purposefully felling trees within the riparian corridor in order to increase the large woody debris component. The resulting decrease in the number of trees near or along stream banks or in the 100 year floodplain has the potential to decrease the effectiveness of standing trees in protecting stream banks and ameliorating the effects of flooding in the floodplain beyond the stream banks. The relative effects, both positive and negative, of this activity in the larger context of forested riparian areas largely managed through natural processes is projected to be quite small.

KARST HAZARDS. Management activities (construction and maintenance of roads, trails, log landings and other facilities; groundwater withdrawals for recreation facilities) may cause, or contribute to causing 1) ground subsidence including sudden sinkhole collapse, 2) sinkhole flooding, and 3) groundwater pollution, including accidental spills of petroleum products. Those Alternatives that have more ground disturbance, such as more miles of road construction/reconstruction and more acres of timber harvested (acres treated), are estimated to have more potential to affect karst-related hazards than those Alternatives with less ground disturbance. Alternative D has the most potential, and Alternative G has the least potential, to affect karst-related hazards. The other Alternatives, listed in order of decreasing potential to affect karst-related hazards are Alternatives A, F, B, E, and I.

Standards under all alternatives provide for 1) buffers around caves and associated features (i. e. sinkholes), and 2) geologic investigations of potential karst hazards as part of the siting, design, and maintenance of roads and other management activities. The standards plus the small areas of carbonate bedrock on the Forest indicate that all Alternatives would avoid or minimize adverse effects on karst-related hazards.

WATERFALLS. Management activities could increase or decrease public exposure to waterfall hazards by improving, limiting, or decommissioning trail access to waterfalls; constructing or removing viewing platforms and other facilities near waterfalls; and restricting, prohibiting or encouraging recreation use at the waterfalls. All the Alternatives maintain existing trails, viewing platforms, and the role of waterfalls as featured recreation sites. All Alternatives provide warning signs to inform visitors about the waterfall hazards. The potential for future fatalities and injuries related to waterfall hazards may increase as future recreation use increases.

Cumulative Effects

LANDSLIDES AND DEBRIS FLOODS. Landslides and debris floods are natural disturbances that have brought episodes of sudden and massive changes to streams, riparian areas, aquatic resources, and watersheds over thousands of years. These disturbances, infrequent and often catastrophic, can be expected to occur sporadically in the future. Within each fifth level HUC watershed, the potential effects of the Alternatives on landslides and flooding would be added to the effects of 1) past, present and future natural landslides and flooding, 2) past and present activities on the Forest (roads, logging, mineral exploration and development, etc), and 3) past, present and future activities off the Forest (roads, logging, mineral exploration and development, etc). The effects of human activities on flooding and landslides on lands now part of the Forest was greatest in the 19th and early 20th century prior to establishment of the Forest in the 1930s. During that period, extensive mountains areas were clearcut logged without the standards of a Forest Plan or the federal regulations that control impacts on floodplains and erosion on the Forest. Railroads were constructed into steep mountain drainages to log hillsides, steep hollows, and floodplains. Forests were cleared and the ground plowed for farming in the mountains. Iron was mined and thousands of trees were cut to make charcoal for iron furnaces on the forest. All these land disturbances taking place in a largely unregulated environment of the 19th and early 20th century had severe impacts on watersheds and flooding. It was severe impacts on watersheds and flooding that lead to the creation of National Forests such as the Jefferson National Forest. Since the creation of the Forest, the previously cutover forest land has been allowed to grow into extensive forests that reduce the effects of natural floods and landslides. The timber harvest and road construction that occurs on the Forest has generally been on a relatively small scale so that each entry leaves most of the forest land intact. Most of the Forest's permanent road system is already constructed.

Considering the thousands of miles of roads (permanent, temporary, skid) that have been built on the Forest over the past decades, and the tens of thousands of acres of timber harvest since the 1930s, the Forest's existing roads system and timber harvest units, as a whole, have a relatively low occurrence of slope failures due to management activities. The Forest's past, present and future roads are generally single lane roads. Single lane roads require less excavation and less fill than two lane roads or four-lane highways, and as a result, has less potential for major cut or fill slope failures. The low occurrence of slope failures due to management activities (roads, timber harvest, mining, etc.) under the previous Forest Plan management indicates that the Alternatives are likely to have a very small incremental effect adding to natural landslide activity.

Within fifth level HUC watersheds, activities off the Forest that might have effects on landslides or flooding include road construction, timber harvest, farming, and residential and urban development. The off Forest land disturbances taking place in a largely unregulated environment of the 19th and early 20th century had severe impacts on watersheds, landslides, and flooding. From the 1930s to the present, the most extensive land disturbances have been occurring off the Forest, not on the Forest. Off the Forest, major land uses changes have been occurring, such as construction of two-lane and four-lane highways, rural and urban development, farming, mineral development, and timber harvest. Recent development off the Forest includes increasing new road construction and residential development in mountainous areas. This trend of increasing development on steep slopes off the Forest is likely to continue into the future. The development of roads and cut and fill construction for residences in mountainous areas do not usually have geologic reports to inventory geologic hazards such as landslides and to consider geologic hazards in siting and design of the development. Future development off the Forest has the potential to cause, or contribute to causing, landslides, and thus, to increase cumulative effects. The past and present development of floodplains and alluvial fans off the Forest for residences, roads, and other purposes has a major effect on the damage that occurs during flooding. Floodplains in or just downstream from mountainous areas are subject to the natural hazard of flooding, and particularly, to the natural hazard of debris floods discharging from steep drainages. Because floodplains are relatively flat lands easy to develop, and because people are attracted to streamside locations, future development can be expected to continue in floodplains. A similar situation applies to past, present, and future activities on alluvial fans, As a result, the potential for increased damage on floodplains and alluvial fans from natural floods can be expected to increase. The Alternatives are not expected add appreciably to the natural hazards of floodplains and alluvial fans.

PHYSICAL ENVIRONMENT

GEOLOGIC RESOURCES

CLIMATE

SOILS

WATERFALLS. For each Alternative, any future injuries associated with recreational use of the waterfalls would be added to past injuries associated with recreational use of the waterfalls to constitute cumulative effects. Past activities include the acquisition, development and maintenance of public access to the waterfalls (including Cascades Falls, Apple Orchard Falls, Roaring Run, and Falls of Little Stony), and providing warnings signs about waterfall hazards. Over the past few decades, numerous injuries have occurred at the waterfalls on the Forest, including a fatality in 2002 at Cascades Falls.

KARST HAZARDS. Most karst areas are located off the Forest. Past and present activities off the Forest have been affecting karst areas for over 200 years. Extensive changes in land use and extensive ground disturbance have occurred. Within fifth level HUC watersheds, activities off the Forest that might have effects on karst hazards include road construction, timber harvest, farming, and residential and urban development. In the future, more development can be expected on karst areas off the Forest. The cumulative effects on karst are largely due to activities off the Forest. The potential effects on karst hazards of any Alternative are expected to be a very minor addition to cumulative effects.

CLIMATE

In this region, extremes are the rule rather than the exception. Average recorded rainfall varies from 35 inches in Giles County, Virginia, to 50 inches in Wise County, Virginia; however, higher and lower readings are not uncommon. On the average, the region receives 2.5 to 4.5 inches of rainfall per month with individual station readings as high as 14 inches per month and as low as 0.2 inches per month. Low rainfall is generally associated with midsummer and late November-December; while passing tropical storms from August through October, provide the highest recorded precipitation.

Rainfall chemistry is monitored at several locations throughout Virginia to track acid deposition. Monitoring locations closest to the Forest are located in Wise, Horton's Station (near Mountain Lake on the New River Valley District), and Roanoke. Results indicate an average precipitation pH of about 4.3. All rain, even unpolluted rain (pH 5.2), is somewhat acidic because of natural compounds. But rain with a pH below 4.7 is usually considered acidic. Precipitation in southwestern Virginia is about 4 times more acidic than this.

Yearly temperatures average 45°F; however, temperatures below zero and above 100° have been recorded. The mean January low is 25°F; the mean July high is 88°F. The growing season ranges from 140 to more than 200 days depending on elevation, aspect and other site conditions.

Regional climate change resulting from emissions of carbon dioxide and other greenhouse gases is not discussed in this analysis. It is recognized that resources in the Forest could be susceptible to climate change, as well as be an important source of removing carbon dioxide from the atmosphere. However, uncertainty concerning the nature of regional climatic changes and global aspects of the phenomenon place this issue outside the scope of the analysis.

SOILS

The soil is a dynamic system composed of living and non-living components that produce a finite resource. It develops slowly from various parent materials and is modified by time, climate, macro- and microorganisms, vegetation and topography. Soils are complex mixtures of minerals, organic compounds and living organisms, air and water. They are a primary component of all ecosystems on the Jefferson National Forest.

Past land use has impacted many of the soils that now occur on the Forest. Extensive logging, mining, grazing and farming occurred on these lands in the late 1800's and early part of the 1900's. Clearcutting and roading to remove timber for sawmills, iron furnaces and mine props were commonly done over vast acreages. Mining and exploration for iron, manganese, sand, and coal occurred throughout the Forest during the same time period, resulting in many acres being disturbed. Some areas were timbered and farmed or grazed prior to Forest Service management, resulting in soils with thin topsoil over subsoil material due to erosion.

The distinct surface geology, climate and topography of each ecological section occurring on the Forest are important factors in the formation of soils on the Forest. Soils in our forest's climate generally require 300 to 1,000 years to recover productivity from complete topsoil removal. Currently, there are 144 soil mapping units recognized on the Jefferson National Forest.

BLUE RIDGE MOUNTAINS SECTION, NORTH AND SOUTH

Significant parts of the Glenwood Ranger District and the Mount Rogers NRA are located within this section. The soils are mainly derived from metamorphic and igneous rock. Igneous parent material is from granite and gneiss on the Glenwood District and rhyolite, tillite and rhythmite on the Mount Rogers NRA. The metamorphic material is derived from quartzite and other rocks.

The soils of the ridgetops and upper one-third of the slopes generally have less depth and are less productive than soils forming on the lower slopes. Rock outcrops are common here. Aspect plays a key role in site productivity and available moisture, as northerly aspects tend to be more moist and productive. This is due to less evapotranspiration and lower soil temperatures on these slopes. Ridgetops and slopes of the higher elevations have soils with a thick, dark organic surface layer. The growing season is shortened at these higher elevations, in part because of lower mean annual soil temperatures.

Some soils derived from granite on upper slopes on the Glenwood Ranger District are underlain by highly weathered granite rock (saprolite). This material has no structure and is unstable on steep slopes when disturbed. Soils derived from igneous rocks on the Glenwood are more productive than those on the Mount Rogers because of differences in the weatherable minerals in the rock types. Soils derived from metamorphic sediments and quartzites have lower productivity on most upper slopes because of a low amount of weatherable minerals associated with these rock types.

Many of the lower and gentler slopes have deeper soils and higher productivity than the soils on the upper slopes. Clay content tends to be higher, as is moisture holding capacity on these landscapes. Some of these soils have a high rock content, both in surface and subsurface layers. Hardened layers (fragipans) have formed in some colluvial (gravity deposited) soils that produce perched seasonal high water tables. Landscapes in meta-sediment areas have less colluvial material and soils tend to be less deep and less productive.

Alluvial (water deposited) soils are associated with larger streams, which have floodplain areas where soil drainage can be variable. Watertables may be seasonally high and are connected to groundwater levels. Some alluvial soils have wetlands occurring. Larger floodplains have a variety of drainage conditions. The smaller drainages have alluvial soils that have very narrow floodplains and better drainage. Rock content in soils of the smaller drainages can be high. Productivity of the alluvial soils in this section is usually high. Plant communities are influenced by high watertables and varying drainage conditions.

CUMBERLAND MOUNTAINS SECTION

Most of the Clinch Ranger District is included in this section. Soils have formed from sedimentary rocks in nearly level stratigraphic beds. Sandstones and shales are intermingled throughout this area. In areas where shales have contributed significantly to soil formation, the soils are higher in clay, higher in productivity and higher in moisture holding capacity. Colluvial soils are common on these landscapes, as are complex slopes having mixed colluvial and residual soils. Drainages are generally rocky and well drained along smaller streams. Drainage conditions vary along larger streams, with some wetlands present. Ridgetops and upper slopes have similar soils as those described for the Ridge and Valley Section. Production is in the high range for the soil types on the Clinch, due to higher rainfall and soil moisture during the growing season.

NORTHERN RIDGE AND VALLEY SECTION

The remainder of the Forest is located within this section. Soils have developed from sedimentary rocks, such as shales, sandstones and limestones. Residual soils of the ridgetops and upper slopes are predominantly derived from sandstone. Soil depths are generally 10-to-40 inches to hard bedrock. Productivity is low, water holding capacity is low and soils are very porous. Rock outcrops and high rock content within the soil are common. Upper slopes, dominated by shale rocks, have very shallow soil depths. This causes rapid runoff during storm events. Most of the shale bedrock is rippable and not hard.

Midslopes are mixed shales and sandstones, relating to extensive folding and faulting of the bedrock layers. The Forest has very little area with soils derived from limestone. Where they occur, these soils are clayey, deep and very productive. Other midslope soils are generally 20-to-60 inches deep to sandstone and less deep when underlain by shale. Soils derived from the shales have a high runoff potential due to shallow depths and steep slopes. Productivity varies as deeper shale-derived soils and soils on northerly aspects have moderate-to-high productivity, and sandstone derived soils and southerly aspects have moderate-to-low productivity.

Lower slopes have deeper soils and more clay in the subsoil. Water-holding capacity and productivity are generally higher. Some colluvial soils on gentle slopes have formed cemented layers (fragipans), which cause perched watertables during the winter and early spring months. Many of the colluvial soils on toeslopes and along drainages have very high rock content throughout the soil profile. Surface stones and boulders are common.

Alluvial soils are commonly well drained along most streams. Larger streams have broader areas of floodplain soils with various drainage conditions. Small areas of organic soils are associated with upland bogs, which generally form in nearly level headwater areas of some watersheds. Wetlands are usually small in extent, and some have been formed behind beaver dams.

OTHER INFORMATION ON THE SOILS

Research indicates that soil productivity is sustained through nitrogen and carbon fixation, mineral release from weathering parent material, decaying organic matter, and translocation of nutrients. The Forest has a completed detailed soil survey on 98 percent of its area. Soil productivity improvement opportunities exist in watersheds with deteriorating soil conditions associated with human and natural causes. Currently, the Forest has an inventory of approximately 1000 acres of watershed improvement needs. These needs include eroding abandoned roads, eroding trails, minespoils, trash dumps, human-impacted riparian areas and illegal off-highway vehicle trails.

The soils on the Forest are important to local and regional communities in these ways:

- Soils support vegetation, which supports wildlife, timber production, and various forest ecosystems.
- Soils, in good condition, produce little sediment to streams and reservoirs.
- Suitable soils are essential to any recreation use and development.
- Suitable soils are essential to a successful road and trail system.
- Watershed improvement project work can help local economies through purchases of supplies, equipment and labor.
- Soils on the Forest are an essential ecosystem component to consider in all the multiple uses the Forest provides to communities in our region.

Direct and Indirect Effects

No specific issues regarding impacts to soils were identified during public scoping for this Forest Plan. The Forest Service is, however, directed by a number of laws, executive orders and policies to protect or enhance long-term soil productivity, while providing for the various uses of the National Forests. Soil productivity is the inherent capacity of the soil to support the growth of plants and can be measured in terms of biomass produced. While we will not measure impacts to soil productivity with biomass since it is difficult to quantify, we will describe impacts to soil productivity with estimates of areal extent (acres). Some of the impacts will be short-term (<100 years) and some will be long-term. We want to show how each alternative will impact long-term soil productivity. The Forest standard for projects identifies a significant impact to soil productivity as a fifteen percent reduction in long-term productivity within an activity area. When long-term soil productivity is reduced on fifteen percent or more of the activity area, then this would be a significant impact to the soil resource and would not be in compliance with the laws guiding Forest Service policy on protecting soil productivity. By identifying impacts to soil productivity and minimizing these impacts to small areas, we can protect the soil's ability to function as an important part of the Forest's ecosystems.

Soil productivity can be affected by several factors and conditions resulting from management activities on the Forest (See Table 3-2). Compaction, erosion, topsoil removal (displacement), land use changes (forestland to parking area), fire and soil improvement (fertilization/liming) can result from actions we take and all of these impact the productivity of the soils. Natural geologic weathering processes (rock to soil), organic decomposition (breakdown of dead biomass), fire, nutrient cycling and atmospheric (precipitation) are also additions influencing soil productivity across the Forest.

Table 3-2. Effects to Soil Productivity from Forest Service actions

Direct Effects	**Indirect Effects**
Compaction	Erosion/soil movement
Land use change	Vegetation removal/nutrient cycling
Displacement (Topsoil removal)	Fire use
Soil improvement	

Key indicators for effects to the soil resource:

- Acres of timber harvest
- Miles of road construction
- Acres of livestock grazing
- Acres of prescribed burning
- Miles of trail construction
- Acres of soil improvement
- Mineral development
- Acres of dispersed and developed recreation use and construction

The Forest and Rangeland Renewable Resources Planning Act (RPA, 1974) requires an assessment of the present and potential productivity of the land. Regulations are to specify guidelines for land management plans developed to achieve the goals of the program that "...insure that timber will be harvested from National Forest System lands only where ...soil, slope or other watershed conditions will not be irreversibly damaged." The National Forest Management Act (1976) amended RPA by adding sections that stressed the maintenance of productivity, the protection and improvement of soil and water resources and avoidance of permanent impairment of the productive capability of the land.

COMPACTION. Soil compaction is dependent upon soil texture, soil structure, soil moisture, ground cover, rock content and the type of activity. Soils are most susceptible to compaction when moisture content is high. Fine textured soils without rock fragments are more at risk. Research has shown that biomass production (a measure of soil productivity) is reduced on compacted soils in the early stages of site recovery. Rutting, increased runoff, erosion and reduced root/plant growth can occur on severely compacted soils. Large areas of the Forest have surface soil characteristics that reduce their susceptibility to compaction. Low clay content and high rock content of the surface soil layers help reduce impacts to soil productivity from compaction. If topsoil removal occurs, generally compaction is more likely, since the subsoil layers of many soils on the Forest have higher clay content and have less rockiness. However, if topsoil removal has occurred, then soil productivity has already been reduced on the area. Compaction is considered a short-term (less than 100 years) effect on soil productivity, since research has shown even severely compacted soils may recover in ten to sixty years where mitigation measures of tilling and reestablishing vegetation have been used. Depth of compaction does not usually exceed six inches with the kinds of equipment being used on the Forest. Actions that can produce soil compaction associated with Forest Plan Alternatives are skid trail (unbladed access routes) use, dispersed recreation use, timber harvesting, grazing and trail use.

LAND USE CHANGE. If a soil on the Forest 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 (greater than 100 years). Land use change is considered a long-term impact to soil productivity.

DISPLACEMENT (Topsoil Removal). Topsoil removal is considered a long-term effect to soil productivity because it involves the loss of the most fertile part of the soil. The organic layer and the A-horizon beneath it are where most of the feeder roots are located for plants and where many of the nutrients needed for soil organisms to grow are found. Many of the Forest's soils are formed in sandstones and shales that are naturally low in plant nutrients. Many are also acidic (low in soil pH). This means the upper layers of soil, where most of the organic material and microorganisms are found, are very important in maintaining the soil's productivity. Many years are needed for the soil to recover its original productivity when the upper layers are removed. Soil formation typically occurs at a rate of one inch per 300-1,000 years, and depends on many environmental factors.

However, areas where topsoil is disposed will be enriched with this added soil material and organic matter. Productivity on these topsoil disposal areas will be improved by increasing soil depth, rooting depth, moisture holding capacity and organic matter. This is *not* to say that where topsoil is removed (long-term loss of soil productivity), soil productivity will be offset by areas where topsoil is deposited (long-term improved soil productivity). It is mentioned here as an indirect effect of excavation activities and to document that not all effects from excavation are negative. Topsoil disposal areas will not be used to show any positive effects of excavation, since the extent of these areas is not easily estimated or displayed. Actions which can produce topsoil removal associated with Forest Plan Alternatives are temporary road and skid road construction, log landing construction, developed recreation use, new trail construction, oil and gas development, fireline dozer construction, special use development and wildlife opening establishment.

SOIL IMPROVEMENT. The Forest works to improve soil quality on about 40-50 acres per year. An inventory of areas on the Forest needing treatment to reduce soil movement, reduce compaction and increase vegetative cover is updated annually. Special emphasis is given to riparian areas to help reduce sediment delivery to stream channels, floodplains and wetlands. Some watersheds may be targeted for this work to tie in with large-scale watershed partnerships, special concerns with species habitats and public water sources. The effects of soil improvement will be considered a long-term positive effect on soil productivity and an improvement of existing soil quality. Soil improvement work will help these treated soils toward recovery of their inherent soil productivity. Actions which would be considered soil improvement associated with Forest Plan Alternatives would include: slope stabilization, erosion control structures and vegetation, road and trail closure, illegal traffic use areas treated for compaction and erosion, abandoned mined land reclamation and trash dumpsite cleanups.

PRESCRIBED FIRE USE. Prescribed burning impacts soils 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 on 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 on this Forest, the effects of fire on the soil are a short-term effect. 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 matter biomass, which adds new organic material to the site.

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

EROSION/SOIL MOVEMENT. An indirect effect of removing a soil's vegetative cover and its organic layer to create bare mineral soil is erosion, meaning soil movement. An undisturbed soil with soil layers intact and growing biomass is not very susceptible to erosion. When soils are disturbed in some way to expose bare mineral soil (A-horizon and lower), then soils on slopes become susceptible to raindrop impact, displacement and overland flow with water. These forces can cause soil to move downslope, sometimes into stream channels, where it then becomes sediment and is incorporated into the bed load of the stream channel. Exposed slopes with low clay soils and soils without many rock fragments are most susceptible to soil movement.

Erosion is considered here as soil movement and not soil loss. Soil material may or may not move from a site or to a stream channel. Many factors influence soil movement and when soil moves, it is deposited somewhere. Depositional areas may benefit from the addition of this eroded soil. Gully erosion is the extreme case of soil movement and would be considered a long-term effect to soil productivity. Gully erosion is evidence that large amounts of soil have moved away and will not be replaced in the short-term (<100 years). Other forms of erosion are not as impactive and would only last until a vegetative cover is established. Gully erosion is difficult to predict and depends on several factors. Erosion will be considered a short-term effect and will be estimated mainly to consider sediment delivery to stream channels.

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 and 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 onsite 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 by the root systems of the remaining vegetation on the treated area. Some nutrients may be leached from the site and reach local streams. This 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 (<5 years). Long-term productivity has been reduced with whole tree harvesting on short rotations, which is not prescribed for this Forest.

Table 3-3. Effects to Soil Productivity by Alternative

Effects to Soil Productivity	**Acres by Alternative**						
	A	**B**	**D**	**E**	**F**	**G**	**I**
Short-Term and Long-Term (First Decade)	4,706	3,395	5,447	3,686	5,131	1,425	4,302
Long-Term (First Decade)	1,507	1,314	1,707	1,118	1,607	892	1,363
Soil Productivity Improved							
First Decade	545	708	568	585	585	708	685
Cumulative	1,200	1,363	1,223	1,240	1,240	1,363	1,340
Long-Term Cumulative Effects (Past and First Decade)	7,692	7,499	7,892	7,303	7,792	7,077	7,548
	Percent of Total Forest Acres by Alternative						
Percent of the JNF with Long-Term Cumulative Effects (Past and First Decade)	1.1%	1.0%	1.1%	1.0%	1.1%	1.0%	1.0%

Cumulative Effects

The cumulative effects to soil productivity from existing conditions and the actions taken during the first decade by each alternative are displayed in Table 3-3. Short-term effects to productivity are associated with removal of ground cover and compaction. Long-term negative effects to soil productivity reflect impacts from soil displacement and land use change due to road construction, dozer firelines, mineral activities, new trail construction, recreation development, special uses and log landings. As shown, the alternatives vary in their impact to long-term soil productivity on the Forest. In the first decade of the plan, Alternative G has the least impact on long-term soil productivity and Alternative D has the most impact. The other Alternatives fall between these two in long-term effects. Long-term cumulative effects take into account the existing conditions on the Forest and add the impacts for the first decade. Soil productivity is being maintained on more than 98% of the Forest area. Cumulative effects to the soils considered all resource management actions taken prior to plan implementation and anticipated actions taken by the alternatives for the first ten years.

AIR RESOURCE

The 1977 and 1990 Amendments to the Clean Air Act (CAA) afford special protection from air pollution to designated Class I areas. The Forest manages one Class I area; James River Face Wilderness (James River Face). Other Class I areas near the Jefferson National Forest are the Shenandoah National Park, and Dolly Sods and Otter Creek Wildernesses on the Monongahela National Forest. The Prevention of Significant Deterioration section of the Clean Air Act (CAA) requires Federal Land Managers to identify Air Quality Related Values (AQRV), or resources important to the Class I areas that might be affected by air pollution. For James River Face these include visibility, water quality and vegetation. The term AQRV will apply to any resources within the National Forest boundary that might be affected by air pollution.

Through a series of legislative and regulatory requirements, federal land management agencies have the unique responsibility to not only protect the air, land, and water resources under their respective authorities from degradation associated with the impacts of air pollution emitted outside the borders of Agency lands (Clean Air Act 1990), but to protect those same resources from the impacts of air pollutants produced within those borders (Clean Air Act 1990, Organic Act 1977, Wilderness Act 1997). Activities from within the forest such as prescribed burning, road construction/maintenance, oil and gas development, recreational use, and timber harvesting all have an impact on the air quality of the forest. It is the responsibility of federal land managers to minimize the impact of these activities on the forest's AQRV, as well as the forest's contribution to air pollution. In light of this responsibility, it is important for federal land managers to understand the impacts of pollution from activities within the National Forest, and also to be familiar with the impacts from pollution sources outside the forest boundary.

The Jefferson National Forest is located in an area of the United States experiencing increasing population growth and the associated demand for electricity and transportation (SAMI 2002). The Forest is located downwind of two major areas of coal-fired power generation, the Ohio River Valley and the Tennessee Valley Authority; and within a day's drive of a large percentage of the United State's population and numerous major cities. Washington DC, Richmond, Raleigh/Durham, and Charlotte, are among the larger urban areas within 125 miles of the Forest. The heavily traveled interstate highway 81 runs the length of the Forest. Nitrogen oxide, sulfur dioxide and fine particulates are the main pollutants emitted from these sources that are affecting resources on the Forest.

PHYSICAL ENVIRONMENT

AIR RESOURCE

Nitrogen oxides are an important contributor to the formation of ground-level ozone on hot sunny days (Chameides and Cowling 1995). The Forest operates an ozone monitor at the Glenwood/Pedlar District Office (near James River Face) in cooperation with the Virginia Department of Environmental Quality (VDEQ). Data collected since 1999 indicates this area is in compliance with the one-hour and 8-hour ozone standards. However, current ozone concentrations at monitors near other parts of the Forest exceed the new 8-hour ozone National Ambient Air Quality Standard (NAAQS). Ozone exposures measured at the Glenwood/Pedlar office and at other sites near the Forest have been high enough to cause growth reductions to sensitive plant species, and may be causing the ozone sensitive species to be less abundant in the forest (SAMI 2002). About 35% of nitrogen oxides affecting the Forest are from power plants (especially during hot summer days when electricity is needed to cool homes and businesses), and about 34% from highway vehicles. Currently there are laws, rules, and regulations in place that will reduce nitrogen oxide emissions 24% by 2010, and 37% by 2040 (in comparison to 1990 emissions) in the Southern Appalachians. The reductions in nitrogen oxide emissions are most likely to lower the highest concentrations of ozone, which may result in ozone having only minimal effects on vegetation growth by the year 2040. Further nitrogen oxide reductions are also anticipated as State and local air pollution control agencies seek ways to attain the new ozone standard in urban areas near the Forest, and in cities to the south and west of the Forest (SAMI 2002). These further reductions in nitrogen oxides will benefit the health of people visiting or living within the Forest, as well as the vegetation.

Acid compounds in clouds, fog, rain and haze are having an adverse impact on visibility and the ability of the soils and streams to buffer acid inputs. Further discussion of the current effects of acid deposition on aquatic resources can be found in the Water Resources and the Fisheries and Aquatic Habitats Sections. Sulfates (sulfur compounds that originate from sulfur dioxide) are the predominant pollutants causing these impacts. Approximately 80% of the sulfur dioxide emissions affecting the Forest are released from coal-fired power plants. Power plants in the Ohio River Valley, Virginia, and West Virginia are most likely to be influencing the acidity and sulfate concentration of rainfall on the northern Districts, while the Tennessee Valley Authority is likely to have the greatest contribution to sulfates on the southern Districts (SAMI 2002). Sulfur dioxide emissions are expected to decrease 23% by 2010, and 61% by the year 2040. This should lead to continued decreases in sulfur deposition on the Forest. However, SAMI found that greater reductions in emissions are needed to protect and improve sensitive resources from the negative effects of acid deposition. Even though sulfur deposition may decrease, acid neutralizing capacity, or the stream's ability to buffer acid inputs, is predicted to continue to decrease in high elevation headwater streams (SAMI 2002). This happens because most soils on the Forest continue to retain at least part of the sulfur that is deposited. Even though sulfur deposition may decrease, soils have been retaining sulfates that will continue to be released and move out of the soil into the stream water. As sulfates are released into the soil water, base cations, such as calcium, may also be removed from the soils. Removal of calcium and other base cations can lead to nutrient depletion and a reduction in soil productivity. This is something the Forest will be investigating over the next planning period.

Regional haze and the reduced visibility observed in the mountains are caused mostly by air pollution, primarily sulfates that originate from coal-fired power plants. The beautiful mountain scenery is one of the main reasons tourists visit the Jefferson National Forest and other areas in Appalachia (Appalachian Regional Commission 1970, Ross 1988). However, there has been a significant reduction in how far a person can see distant views, as well as the clarity of that view. The estimated natural background visibility for the eastern United States is 93 ± 28 miles (NAPAP 1991), but median visibility at James River Face is now only 26 miles. Fine particles ($PM_{2.5}$) primarily responsible for visibility impairment are formed when combustion gases are chemically transformed into particles.

In the eastern United States, sulfate particles (transformed sulfur dioxide) from coal-fired power plants comprise most of the measured fine particle mass (IMPROVE 2001).

The clearest days at James River Face have the lowest fine particle mass (6.07 ug/m3) and estimated visibility is 45 miles (using the annual average relative humidity of 82 percent). On the highest mass (22.53 ug/m3) days the visibility is reduced significantly to 14 miles. The days with the poorest visibility are most likely to occur starting in May and continue through September (Air Resource Specialists 1995) during the time when most people are visiting the Forest. Throughout the year, people are most likely to see a uniform haze-like a white or gray veil that obscures the scenery (Air Resource Specialists 1995). Sulfates are the most important fine particles contributing to visibility impairment. On the low mass days they comprise 47% of the total mass while on the highest mass days the sulfates are 60% of the total. Organics (released primarily from vegetation as volatile organic compounds) are the second most important fine particles measured, and if organics were the most abundant particulate species, then there would be a bluish cast to the mountains, hence the name Blue Ridge Mountains.

Further reductions by coal-fired power plants in North Carolina (as a result of recent legislation) and the Tennessee Valley Authority, would benefit visibility on the southern end of the Forest, but not at James River Face where emissions from the Mid-west play a bigger role in visibility impairment (SAMI 2002). SAMI estimated that once the current laws, rules and regulations are implemented, visibility would improve by only three miles by the year 2040. Additional emission reductions will be needed to reach the national visibility goal of “natural visibility conditions by the year 2064” (CAAA 1990, EPA 1999).

The fine particles that cause visibility impairment can also be unhealthy for people, because 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 such as asthma, decreased lung function, and even premature death (EPA 1997). Sensitive groups at greater risk include the elderly, individuals with cardiopulmonary disease, and children. For this reason, fine particle levels are monitored. Monitoring results for fine particulates include both primary particulate (that are emitted directly from a source) and secondary particulate (resulting from transformation of gases in the atmosphere). The Environmental Protection Agency has established NAAQS for fine particles ($PM_{2.5}$) based on three-year averages of monitored data. Table 3-4 presents results from monitors near the Forest that indicate that the annual average $PM_{2.5}$ standard may have been exceeded at the Roanoke and Bristol, VA sites. The 24-hour average (note the maximum values are presented and not the 98th percentile) does not appear likely to be exceeded when the data from the closest monitoring sites to the Forest are averaged for three years.

There is a high likelihood that the Johnson City-Kingsport-Bristol and Roanoke metropolitan statistical areas (MSAs) will be designated as non-attainment for fine particulates and ozone. The summit of Whitetop Mountain (the portion in Smyth County above 4500 feet) was designated a marginal, rural-transport, non-attainment area for the one-hour ozone standard in 1988. Failure to maintain a consistent ozone-monitoring program at this site leaves its non-attainment status in question. The Environmental Protection Agency will ultimately decide if any other areas affecting the Forest will be designated as non-attainment for fine particles or ozone. It is of particular importance for fire managers to mitigate prescribed fire emissions, to the greatest extent practical, during those days characterized by existing or predicted high ambient air pollution. The $PM_{2.5}$ standard may require fire managers to be even more vigilant in smoke management to protect the health and welfare of citizens on and off Forest lands from the effects of particulate matter emissions associated with prescribed fire.

Once an area is designated non-attainment, a State Implementation Plan (SIP) is developed in attempt to bring the area back into attainment of the standard. This usually involves placing controls on various sources that contribute to the pollutant of concern in order to lessen or minimize their emissions. However the state air regulatory agency (Virginia Department of Environmental Quality) did not develop a plan for Whitetop Mountain, because the non-attainment area contains no emission sources. This is an unusual situation. For all other non-attainment areas in Virginia, SIPs have been developed based on emission inventories of contributing sources of pollution. The current emission inventories do not accurately reflect emissions from prescribed burning. Considering that 70% of the particulate emissions from prescribed fires are fine particles, and nitrogen oxides and volatile organic compounds are also released, state air regulators will be interested in these emissions. The Forest will need to interact closely with the Virginia Department of Environmental Quality to ensure that Forest prescribed fire emissions (and perhaps other Forest activities) are accurately considered in State Implementation Plan development.

Direct and Indirect Effects

As an ecological process, wildland fire is essential in creating and maintaining functional ecosystems and achieving other land use objectives. However, smoke is a byproduct of prescribed fire that affects air quality. All emissions from wildland fires are generated from the incomplete combustion of fuel, and include: particulate matter, carbon monoxide, carbon dioxide, nitrogen oxides and hydrocarbons (Hardy, et al. 2001). The single-most important emission in smoke is fine particulate matter less than 2.5 microns in diameter ($PM_{2.5}$) because it limits visibility, absorbs harmful gases, and aggravates respiratory conditions in sensitive individuals. Fine particulates ($PM_{2.5}$) make up more than 70% of the mass of particulate matter produced by wildland fire. 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). The challenge in using wildland fire is balancing the public interest objectives of protecting human health and welfare (from air pollution) and sustaining ecological integrity. The EPA recognizes this challenge and developed an interim air quality policy on wildland and prescribed fires with the public policy goal to allow fire to function, as nearly as possible, in its natural role in maintaining healthy wildland ecosystems, and to protect public health and welfare by mitigating the impacts of air pollutant emissions on air quality and visibility (EPA 1998).

In order to minimize the negative effects of smoke and associated pollutants on human health and visibility, smoke management plans are a required part of every prescribed fire burn plan. The negative effects of smoke can be reduced by planning and executing prescribed fires on days that maximize smoke dispersion and avoid smoke-sensitive areas. For each prescribed burn conducted, the Forest Service determines smoke dispersion characteristics that must be met in the weather forecast for the day of the burn. These characteristics include: the depth of the atmosphere available for smoke mixing (dispersion), transport wind speed and direction, and the probability of air mass stagnation during the day. Forest Service smoke management guidelines include:

- Predicting smoke behavior for the weather conditions anticipated during the burn.
- Determining if there are smoke-sensitive targets (public or private ownership) within the probable smoke impact area and coordinating with them to avoid or mitigate problems.
- Monitoring the actual weather conditions and smoke behavior to make sure they occur as predicted.
- Being prepared to cease ignition and/or initiate suppression if the weather changes from the forecast and causes smoke behavior problems that cannot be mitigated.

Table 3-4. Fine particulate annual average and 24 hour max values (ug/m^3) for the given site.

State	County	Site AIRS Code	Fine Particulate Matter (ug/m3) 2000 Annual Avg	2000 24 Hr Max	2001 Annual Avg	2001 24 Hr Max	2002 Annual Avg	2002 24 Hr Max	2000 - 2002 3 Yr Avg of Annual Avg
VA	Page Co	51-139-0004	13.3	69.4E*	13.3	43.1	13.2	40.6	13.3
VA	Bristol	51-520-0006	16.4	52.8E	15.2	43.4	14.1	37.3	15.2
VA	Lynchburg	51-680-0014	---	37.1E	14.4	50.2	13.8	35.4	---
VA	Roanoke	51-770-0014	15.9	39.4E	14.8	49.2	14.4	39.5	15
VA	Salem	51-775-0010	15.5	43.6E	15.1	52.8	15.1	40.7	15.2
WV	Mercer Co	54-055-0002	13.6	34.9	14.09	37.4	12.36	44.3	13.4
WV	Summers Co	54-089-0001	10.38	32	11.83	50.9	10.16	49.4	10.8

* Air quality sampling, analysis and reporting are the results of joint effort of the Va. DEQ, West Va. DEP and the US EPA. Data summaries were obtained from VA's DEQ Annual Ambient Air Monitoring Data Reports, West VA's DEP Annual Air Quality Reports and EPA AIRS website. Note that for the year 2000, 24 hour max values denoted by the letter "E" were influenced by the fires in October and November of 2000. These values were included in the No. of Observations, but were excluded from both the 4th Qtr. and Annual Arithmetic Means, and the 98th Percentile value, and will not be used in determining compliance with the NAAQS (Virginia DEQ Annual Ambient Air Monitoring Data Report). Though the 24-hr max is shown above, the 98th percentile of the 24 hour averages is used in calculating an exceedence, not the maximum 24-hr value.

State	County	Site AIRS Code	Ozone (ppm)** 2000	2001	2002	2000 - 2002 3-Year Avg
TN	Sullivan Co	47-163-2003	.097	.086	.093	.092
VA	Frederick Co	51-069-0010	.079	.086	.091	.085
VA	Shenandoah NP	51-113-0003	.080	.090	.086	.085
VA	Page Co	51-139-0004	.076	.086	.079	.080
VA	Roanoke Co	51-161-1004	.081	.089	.091	.087
VA	Rockbridge Co	51-163-0003	.077	.082	.078	.079
VA	Wythe Co	51-197-0002	.082	.076	.085	.081
WV	Greenbrier Co	54-025-0003	.083	.083	.082	.083

** Units reported in parts per million. Air quality sampling, analysis and reporting are the results of joint effort of the Va. DEQ, Tenn. and West Va. DAQ and the US EPA. Data summaries were obtained from the following sources: VA's DEQ Annual Ambient Air Monitoring Data Reports for 1999, 2000 and 2001, Pat Adkins with West VA's DAQ and Jackie Waynick with Tenn's DAPC.

Application of the precautionary and mitigation measures described above will limit the risk and severity of any problems that might occur from prescribed fire smoke.

As shown in the Affected Environment section, some counties within or near the Forest boundary may exceed the National Ambient Air Quality Standards for $PM_{2.5}$ and become non-attainment areas. Alternatives A, B, D, E, G, and I all propose increasing the use of prescribed fire over current levels. For this reason, particulate matter emissions were estimated for each Alternative, and compared to: 1) historic prescribed fire emissions; and 2) primary fine particulate emissions from other sources within the counties containing national forest system lands. These counties are referred to as the "analysis area".

Direct effects of the prescribed fire programs on $PM_{2.5}$ emissions, by Alternative, were calculated for the minimum and maximum number of planned acres (based on best estimates of fuel type, fuel consumption rates and emissions rates for different burning regimes). Actual acres burned in any given year, and resulting $PM_{2.5}$ emissions, will depend on weather conditions and other factors that must be considered prior to initiating a prescribed fire. Cumulative effects were calculated similarly, but with the addition of expected prescribed fire programs on lands near the Forest.

Current $PM_{2.5}$ emission levels were taken from the EPA 1999 emissions inventory available at http://www.epa.gov/air/data/netdb.html.

Prescribed fire programs in all Alternatives would produce more $PM_{2.5}$ than the current program, resulting in increases of approximately 900-1700 tons per year over current levels. Alternatives B and G would produce the greatest amount of $PM_{2.5}$, Alternatives A, D and I would produce slightly less. $PM_{2.5}$ emissions from Alternative E would result in the smallest increase.

On average, the Forest has burned 2,931 acres annually since 1996, and estimated $PM_{2.5}$ emissions from this program would be 196 tons. The largest prescribed fire program over the last 10 years occurred in 1998 when 11,800 acres were burned. $PM_{2.5}$ emissions that year were estimated at 1,000 tons. Emissions from the minimum burn program for all Alternatives would be equal to or less than those in 1998. The maximum program for all Alternatives, except E, would exceed the 1998 emissions by 20-65%.

Table 3-5. Particulate matter ($PM_{2.5}$) emission estimates, in tons per year, by Alternative compared to current, inventoried, primary $PM_{2.5}$ emissions within counties containing Jefferson National Forest system lands.

			Percent Increase in $PM_{2.5}$ Emissions over Current Levels			
	Estimated annual $PM_{2.5}$ emissions in tons		Direct / Indirect Effects of Prescribed Fires Planned on Forest		Cumulative Effects of Prescribed Fires Planned on Forest and Adjacent Lands	
Alternative	**Minimum**	**Maximum**	**Minimum**	**Maximum**	**Minimum**	**Maximum**
A	941	1,183	3	4	4	5
B	1,070	1,646	4	6	4	6
D	951	1,253	3	4	4	5
E	681	767	2	2	3	3
G	985	1,326	4	5	4	5
I	968	1,260	3	4	4	5
F-current	105	196	0	0	1	1

Cumulative Effects

The only additional prescribed fire activity anticipated in the vicinity of the Forest would occur on approximately 1,750 acres of adjacent George Washington National Forest Districts. Emissions from these burns are estimated to contribute 154 tons annually to $PM_{2.5}$ concentrations.

Emissions from prescribed fire are only one of many sources of $PM_{2.5}$ pollution. Fine particulates can be emitted directly into the atmosphere or can be created from gaseous pollutants that are chemically transformed into particulates (sulfur dioxide is transformed into sulfate particles). Only those particulates emitted directly into the atmosphere (primary pollutants) are tracked in emission inventories. The most recent emissions inventory available from the Environmental Protection Agency estimates primary $PM_{2.5}$ emissions within the analysis area at 24,843 tons (EPA 1999). Emissions from the proposed Alternatives would account for a 2-6% increase in primary $PM_{2.5}$ emissions in the analysis area. In reality the contribution to $PM_{2.5}$ would be even less because a large amount of monitored $PM_{2.5}$ secondary particulate (formed from gaseous pollutants such as sulfur dioxide). Secondary particulates are not included in the emission inventory. It should also be recognized that EPA's current $PM_{2.5}$ emission inventory is not accurate for prescribed fire emissions, but state air regulators and EPA are working to improve the estimates. It will be important for the Forest to work with the Virginia Department of Environmental Quality and others to incorporate Forest Service emissions into future emission inventories that will be needed to develop attainment plans.

The projected emissions from prescribed fires are not expected to be a large contributor to total fine particulate matter mass nor any exceedence of the fine particle National Ambient Air Quality Standard (NAAQS). However, the Forest will be expected to follow Conformity Determination rules and disclose any prescribed fire emissions for activities planned in non-attainment areas.

WATER RESOURCE

The Southern Appalachian Mountain region has abundant rainfall, which produces and maintains water flow through a vast network of perennial streams. These mountain streams serve as water supplies for mountain and foothill communities and, ultimately, major cities of the eastern and southeastern United States.

The Forest is located within the James, Roanoke, New, Holston, Clinch, Big Sandy, and Cumberland River watersheds. The major streams in the James River basin that drain the Forest are Craigs Creek, Jennings Creek, and the James River. New River basin streams include Wilson Creek, Fox Creek, Cripple Creek, Toms Creek, Stony Fork, Walker Creek, Wolf Creek, and the New River. The South and Middle Forks of the Holston are the main drainages in the Holston watershed. The Pound River is the main drainage of the Big Sandy watershed. In the Clinch drainage the main streams are the North Fork of the Clinch River, Clinch River, Guest River, and Powell River. Only small portions of the Forest are located in the Roanoke and Cumberland drainages.

National forest system lands are typically the mountainous headwaters in each of these systems. As such, the streams on the national forest are typically small high-gradient, high-energy systems. There are approximately 1,053 miles of perennial stream channel on the Forest. Water yield for the Forest averages 16.6 area-inches per year. This is not distributed uniformly in time or space. Based on streamflow information from the U.S. Geological Survey stream gauging stations, the average annual runoff from the national forest varies from approximately 14.5 area-inches to almost 20 area-inches of runoff per year (van der Leeden, 1993). The data are from watersheds of hundreds of square miles in area, and may not accurately represent this national forest's streamflow. The steep high elevation watersheds of the Jefferson National Forest are likely produce even larger volumes.

Streamflow represents a "leftover" of precipitation minus evaporation and water use by growing vegetation. As such, it is extremely variable. Streamflow varies by year and by time of year. May, June, July, and October are months with the highest precipitation. However, March is the month with highest streamflows. This occurs because the high precipitation months are also during the growing season when much of the precipitation is used by vegetation. Streamflows are typically lowest in late summer and early autumn at the end of the growing season. November is the month with lowest precipitation, prolonging the duration of low flows.

FLOODS AND DROUGHTS

The watersheds of the Jefferson National Forest periodically experience extreme flow events. Virginia lies in the path of cyclone storms that originate in the Gulf of Mexico and the Atlantic Ocean and carry large amounts of moisture. Flooding is common in the state, especially in the western mountain regions, where high precipitation and steep topography produce rapid runoff. The lands of the Jefferson National Forest have been touched by floods of magnitude greater than 50 year recurrence interval in 1940, 1969, 1972, 1977, and 1985, as well as 1996 (van der Leeden, 1993). Most of these were produced by hurricanes. The potential for flooding is greatest when soils are near saturation as they are in the spring or at any time of year following several days of rain. The presence of a forest canopy in a watershed can reduce flood peaks from small-to-moderate storms during the growing season because the growing trees utilize soil moisture and transpire it to the atmosphere. This soil moisture difference becomes negligible during large-storm events. A small mountain watershed on the Jefferson National Forest can produce flood peaks approaching 1,000-cubic feet per second, per square mile. In contrast, a larger river basin like the James River at Holcomb Rock will have a maximum peak discharge of only 50-cubic feet per second, per square mile.

Low flows typically occur during late summer and early autumn when precipitation is low and soil moisture is utilized by growing vegetation. Water in the stream represents the release of water from groundwater and soil storage. Because of the wide range in topography, rock types, and soils, there is a wide variation of low flows in the streams of the Jefferson National Forest. Where soils are deep, slopes are gentle, and drainage density is low, precipitation can be stored within the watershed and released slowly. Thus, peak flows are moderated and low flows are sustained. As greater flow contributions are from groundwater, water temperature is usually lower and less variable. Based on years of data from USGS stream gages across the Forest, low flows are highest in the Blue Ridge. For the same low flow recurrence interval, streams in the Valley and Ridge have one half of the flow rates of Blue Ridge streams. Cumberland Plateau streams have the lowest low flows, producing only one tenth the flow rate of Blue Ridge streams for the same recurrence interval. The lowest low flows from Jefferson National Forest streams occur in Stony Creek and Little Stony Creek on the Clinch District.

EFFECTS OF GREAT FLOODS

Historically, the great floods in southwest Virginia have been associated with hurricanes, which form part of the ecological disturbance regime for aquatic ecosystems. The way that a watershed responds to a hurricane event is strongly influenced by watershed condition and also by natural factors of sensitivity. A healthy watershed is resilient and can rapidly recover from the effects of a large flood. A watershed under stress from historic or ongoing land uses may show disproportionately more watershed damage and channel impacts, and will take much longer to recover. The watersheds of the Appalachians are in the process of seeking a new equilibrium in response to the loss of American chestnut from the forests. Because of its resistance to rot, large woody debris produced from downed chestnuts would persist for decades and add stability to headwaters streams. Hemlock woolly adelgid may reduce the presence of hemlock; another species that contributes stability to stream channels.

WATER QUALITY (AQUATIC ECOLOGICAL INTEGRITY)

Water quality on the Jefferson National Forest is affected by nonpoint sources of pollution that can affect the physical, chemical, or biological integrity of Forest streams. Collectively, these factors make up the water's aquatic ecological integrity. Nonpoint sources of pollution on the Forest include road construction and maintenance, timber harvest, dispersed and developed recreation management, fisheries and wildlife habitat improvement, range management, and mining. The largest potential impact on water quality from our management activities is from an increase in sediment in streams that can affect the physical integrity of streams. Monitoring has not been conducted to characterize stream condition or trend relative to sediment from management activities.

Activities off the Forest are affecting the chemical integrity of Forest streams. As discussed in the Air Resources section, acid deposition from industry and automobiles are causing many streams to become more acidic. The Forest participates in the Virginia Trout Stream Sensitivity Survey in which a number of streams across the Forest are monitored four times per year. Of these, more than half are considered to be acid sensitive and one-third is moderately acid sensitive. A more extensive monitoring program is underway to characterize the chemistry and stream insects of most of the Forest's streams.

Table 3-6. Miles of Impaired Stream Segments by 5th Level Watershed

Watershed	Miles
02080203	182
02080201	72
03010101	384
05050001	161
05050002	45
05070202	86
06010101	107
06010102	112
06010205	121
06010206	63
Total	**1,354**

Some stream segments within the watersheds touched by the Jefferson National Forest do not meet Virginia water quality standards and are designated as impaired. As required by section 303(d) of the Clean Water Act, these streams are listed by the Virginia Department of Environmental Quality in a report produced every four years called a "Total Maximum Daily Load (TMDL) Report" (DEQ, 2002). The leading causes of impairments were violation of the fecal coliform bacteria standard and violations of the general standard (DEQ, 2002). The general standard states that Virginia's waters "will support the propagation and growth of all aquatic life...which might reasonably be expected to inhabit them." Other impairment causes include violations of the standards for ammonia, PCB's, dissolved oxygen, pH, and tributyltin. Table 3-6 lists the miles of impaired stream segment in each fourth level Hydrologic Unit Code (HUC) watershed containing Jefferson National Forest land. In all cases, the impaired segments are downstream from the National Forest.

Other streams are recognized for their high quality waters. As part of the antidegradation provisions of Virginia water quality standards (Commonwealth Of Virginia, 1997), waters which constitute an outstanding national resource or waters of exceptional recreational or ecological significance are designated as "Tier III" waters. Currently, only a segment of North Creek in Botetourt County and tributary to the James River has been so designated. Little Stony Creek tributary to the New River is under consideration.

CONDITION OF WATERBODIES

There is general agreement that water quality has improved significantly since the adoption of the Clean Water Act in 1972. Recently, the rate of water quality improvement has slowed since most of the municipal and industrial discharges currently control pollution and protect water quality, while the remaining sources of pollution, such as storm-water runoff, sediment contamination, and spills are more difficult and expensive to control (SAMAB).

The Chesapeake Bay drainage area has the highest percentage of waterbodies that meet water-quality standards for the protection of aquatic life in the Southern Appalachian Assessment area. While the aquatic life uses are fully supported in more than 99 percent of the James River watershed, there are elevated levels of fecal coliform contamination in the eastern portion of this watershed (SAMAB 1996). The Tennessee River Basin is the most severely impacted basin in the Southern Appalachian Assessment Area. The most severe impacts are found in the French Broad and Holston River watersheds and the main stem of the Tennessee River itself. These impacts are attributed to urbanization, resource extraction, and the hydrologic modification of the Tennessee River system (SAMAB 1996).

The portion of the Ohio River basin within the Southern Appalachians includes the New River watershed in North Carolina and Virginia, which appears to be above-average condition; however, there are a significant number of miles not supporting designated uses because of the impacts from mining operations (SAMAB 1996).

Because of the expected population growth and associated development, as well as potential increase in resource extraction and agriculture and silviculture activities in the SAA area, future water quality in some areas may be at risk to impairment (SAMAB 1996).

WATER USES

Water on the Jefferson National Forest is needed for recreation, wildlife, domestic livestock watering, and administrative uses by the Forest Service. Additionally, instream flow quantities and timing are necessary to maintain the capacity of the channels to transport water and sediment, for fisheries, recreation, and visuals. Water sources on the Forest and adjacent to it are utilized for individual water supplies. Individual supplies for human consumption generally come from shallow-drilled wells or springs. At least 11 communities use water from the Forest for all or part of their water supplies. The following is a list of the watersheds utilized for municipal and community water supplies:

- Ben's Branch of Powell River
- South Fork of Powell River
- Benge's Branch of Powell River
- Stony Creek of Big Otter River
- Whitetop - Laurel Creek of South Fork of Holston River
- Staley Creek of Middle Fork of Holston River
- Peak Creek of the New River
- John's Creek, fork of Craig Creek
- Mill Creek of New River
- Slemp Creek of Smith Fork of Holston River
- North Fork of Clinch River

Water usage of national forest system lands in the Southern Appalachians range from 1,700 gallons per day in Alabama to 1,315,000 gallons per day in Virginia. Of the usage in Virginia, 1,126,000 gallons (86 percent) are drawn from the Holston River. Industrial withdrawals from the Holston River for Sullivan County, Tennessee, and for Scott and Washington Counties, Virginia, are the highest in the SAA area. Water withdrawn from the Holston River for fish and wildlife (614,000 gallons per day) represents the largest use on national forest land in the SAA area (SAMAB).

GROUNDWATER

The groundwater resources of the Forest vary, depending on the different hydrogeologic characteristics of the three geomorphic provinces. Quality of groundwater varies depending on whether the well is drilled in shale, sandstone, granite or limestone. Groundwater on and adjacent to the Forest arises as an issue from time to time in regard to the alleged effect of some Forest activity on the groundwater.

Most of the rural population in western Virginia receives its water supplies from groundwater. Since most of the population is in the valleys, most of the water wells are also in the valleys. The Forest generally is located in the sparsely populated mountains. So there are very few drilled wells on the Forest. As a result, there is a general lack of detailed information on groundwater on the Forest.

Groundwater within the three physiographic provinces of the Forest mostly occurs within the secondary porosity and permeability features, such as fractures, joints, shears, fault zones, leached-out cements, and solution channels.

Limestone and other carbonate rocks are the units with the greatest potential for groundwater development. They produce good water quality and large volumes; however, they can be easily contaminated.

A regional summary of the groundwater associated with the three distinct physiographic provinces is as follows:

- Blue Ridge Mountains Geomorphic Province - generally small amounts of good quality groundwater available from the fractured crystalline bedrock.
- Ridge and Valley Geomorphic Province - moderate-to-large supplies of groundwater within the limestone units. Distinct karst and cavernous features present. Shales and sandstones generally are poor to fair groundwater producers.
- Appalachian Plateau Geomorphic Province - limited amount of groundwater obtainable because of a combination of topography, rock types, and rock structure. Recharge potential is limited on the ridgetops.

HYDROLOGIC UNIT CODE WATERSHEDS

The United States is divided and sub-divided into successively smaller hydrologic units, which are classified into four levels: regions, sub-regions, accounting units, and cataloging units. The hydrologic units are arranged within each other, from the smallest (cataloging units) to the largest (regions). Each hydrologic unit is identified by a unique hydrologic unit code (HUC) consisting of two to eight digits based on the four levels of classification in the hydrologic unit system.

The first level of classification divides the Nation into 21 major geographic areas, or regions. These geographic areas contain either the drainage area of a major river, such as the Missouri region, or the combined drainage areas of a series of rivers, such as the Texas-Gulf region, which includes a number of rivers draining into the Gulf of Mexico. Eighteen of the regions occupy the land area of the conterminous United States. Alaska is region 19, the Hawaii Islands constitute region 20, and Puerto Rico and other outlying Caribbean areas are region 21.

The second level of classification divides the 21 regions into 222 subregions. A subregion includes the area drained by a river system, a reach of a river and its tributaries in that

(Continued on page 32)

Table 3-7. Names and Hierarchy of Watersheds within the Jefferson National Forest

Region / Subregion / Accounting Unit / Cataloging Unit / 5th Level	6th Level	Watershed Name
02 Mid-Atlantic		
0208 Lower Chesapeake		
020802 James		
02080201 Upper James		
030	I10	Upper Potts Creek
"	I11	Lower Potts Creek
070	I18	Upper James River / Sinking Creek / Mill Creek
"	I24	James River / Lapsley Run
"	I25	Catawba Creek
"	I26	Looney Creek / Mill Creek
080	I19	Upper Craig Creek
"	I20	Meadow Creek
"	I21	Johns Creek
"	I22	Lower Craig Creek / Patterson Cr. / Lower Barbours Cr.
"	I23	Upper Barbours Creek
090	I27	James River / Jennings Creek
"	I28	James River / Elk Creek / Cedar Creek
02080202 Maury		
050	I38	Buffalo Creek
02080203 Middle James-Buffalo		
010	H01	James River / Reed Creek
"	H02	Pedlar River
"	H03	James River / Blackwater Creek / Ivy Creek
"	H04	Harris Creek
03 South Atlantic-Gulf		
0301 Chowan-Roanoke		
030101 Roanoke		
03010101 Upper Roanoke		
010	L01	South Fork Roanoke River / Bottom Creek / Elliot Creek
"	L02	North Fork Roanoke River / Bradshaw Creek
020	L03	Upper Roanoke River
"	L04	Roanoke River / Mason Creek
"	L05	Tinker Creek / Carvin Creek / Glade Creek
"	L06	
070	L20	Upper Goose Creek
080	L23	Upper Big Otter Creek
"	L24	North Otter Creek
"	L25	Big Otter River / Elk Creek
"	L26	Little Otter River / Machine Creek
"	L27	Big Otter River / Buffalo Creek
"	L28	Lower Big Otter River
"	L29	Flat Creek

Table 3-7 Cont'd. Names and Hierarchy of Watersheds within the Jefferson National Forest

Region / Subregion / Accounting Unit / Cataloging Unit / 5th Level	6th Level	Watershed Name
05 Ohio		
0505 Kanawha		
050500 Kanawha		
05050001 Upper New		
010	N01	Helton Creek / Big Horse Creek
030	N02	Upper New River / Wilson Creek
"	N04	New River / Peach Bottom Creek / Little River
040	N05	Elk Creek
"	N06	New River / Chestnut Creek / Brush Creek
050	N03	Fox Creek
060	N07	Crooked Creek
"	N08	New River / Shorts Creek / Pine Run
070	N09	Cripple Creek
080	N10	Upper Reed Creek
"	N11	Lower Reed Creek
"	N12	Cove Creek
100	N16	New River / Claytor Lake / Macks Creek
"	N17	Peak Creek
"	N18	New River / Crab Creek
"	N22	New River / Toms Creek / Back Creek / Stroubles Creek
05050002 Middle New		
010	N23	New River / Sinking Creek
"	N24	New River / Little Stony Creek
"	N28	Stony Creek
020	N25	Walker Creek
"	N26	Kimberling Creek
"	N27	Little Walker Creek
030	N30	Upper Wolf Creek
"	N31	Hunting Camp Creek
"	N32	Lower Wolf Creek / Clear Fork
"	N33	Laurel Creek
040	N29	New River / East River
"	N35	New River / Adair Run
070	N34	Rich Creek
0507 Big Sandy-Guyandotte		
050702 Big Sandy		
05070202 Upper Levisa		
030	Q09	Upper Russell Fork
"	Q10	Russell Fork / Lick Creek / Fryingpan Creek
"	Q12	Russell Fork / Russell Prater Creek
050	Q13	Pound River
"	Q14	Cranesnest River

Table 3-7 Cont'd. Names and Hierarchy of Watersheds within the Jefferson National Forest

Region / Subregion / Accounting Unit / Cataloging Unit / 5th Level	6th Level	Watershed Name
06 Tennessee		
0601 Upper Tennessee		
060101 French Broad-Holston		
06010101 North Fork Holston		
010	O09	Upper North Fork Holston River
"	O10	North Fork Holston River / Laurel Creek
"	O11	North Fork Holston River / Wolf Creek / Tumbling Creek
06010102 South Fork Holston		
010	O01	Upper South Fork Holston River
"	O02	South Fork Holston River / Whitetop Laurel Creek
020	O03	Upper Middle Fork Holston River
"	O04	Middle Fork Holston River / Hungry Mother Creek
"	O05	Lower Middle Fork Holston River
060102 Upper Tennessee		
06010205 Upper Clinch		
020	P04	Clinch River / Swords Creek / Lewis Creek
"	P05	Little River
040	P09	Clinch River / Little Stony Creek
"	P10	Lick Creek
"	P11	Guest River
"	P12	Stony Creek
050	P13	Clinch River / Stock Creek / Cove Creek
"	P15	North Fork Clinch River
"	P16	Clinch River / Blackwater Creek
06010206 Powell		
010	P17	Upper Powell River / Callahan Creek / Roaring Fork
"	P18	South Fork Powell River
"	P19	Powell River / Camp Creek
"	P20	North Fork Powell River
020	P22	Wallen Creek

reach, a closed basin(s), or a group of streams forming a coastal drainage area.

The third level of classification subdivides many of the subregions into accounting units. These 352 hydrologic accounting units nest within, or are equivalent to, the subregions.

The fourth level of classification is the cataloging unit. A cataloging unit is a geographic area representing part of all of a surface drainage basin, a combination of drainage basins, or a distinct hydrologic feature. These units subdivide the subregions and accounting units into smaller areas. There are 2150 Cataloging Units in the Nation. Cataloging Units sometimes are called "watersheds."

Fourth level HUC watersheds are divided into even smaller units. The fifth level of classification is the subwatershed. The Jefferson National Forest lies within parts of 36 fifth code HUC watersheds. The watersheds range is size from 33,620 acres to 250,800 acres. Average size is 150,000 acres, or 230 square miles.

These are further divided into sixth level drainage units. The sixth level HUC is the smallest unit currently being addressed by the Jefferson National Forest Plan Revision. Table 3-7 describes the hierarchy of watersheds included within the Jefferson National Forest.

SEDIMENT YIELDS

The existing annual sediment yield of a watershed provides an indication of its current condition as influenced by past and ongoing land uses on private and public lands. When annual sediment yield is expressed as a unit value (tons per square mile), watersheds may be compared with one another. Sediment yields were estimated using a Geographic Information Systems (GIS) procedure described in the process paper *Sediment Yields and Cumulative Effects for Water Quality and Associated Beneficial Uses*. The procedure models erosion spatially on a 30 meter grid based on factors including land use, slope class and physiographic zone, and routes the erosion value to the mouth of the fifth code HUC watersheds as annual sediment load in tons. This value is divided by the watershed area in square miles and displayed in Figure 3-2. To place these values in perspective, small fully forested watersheds in the eastern United States have an average annual sediment yield of approximately 50 tons per square mile per year (Patric et al. 1984). Increases above this are attributable to land uses other than forest including roads, mining, agriculture, and urban.

Future sediment yields were estimated using the same method used to estimate existing sediment yields. Different land uses have corresponding values of unit erosion. These land uses include the various management prescription assignments, allowable activities, and outputs by alternative. These values were used in modeling not only background and

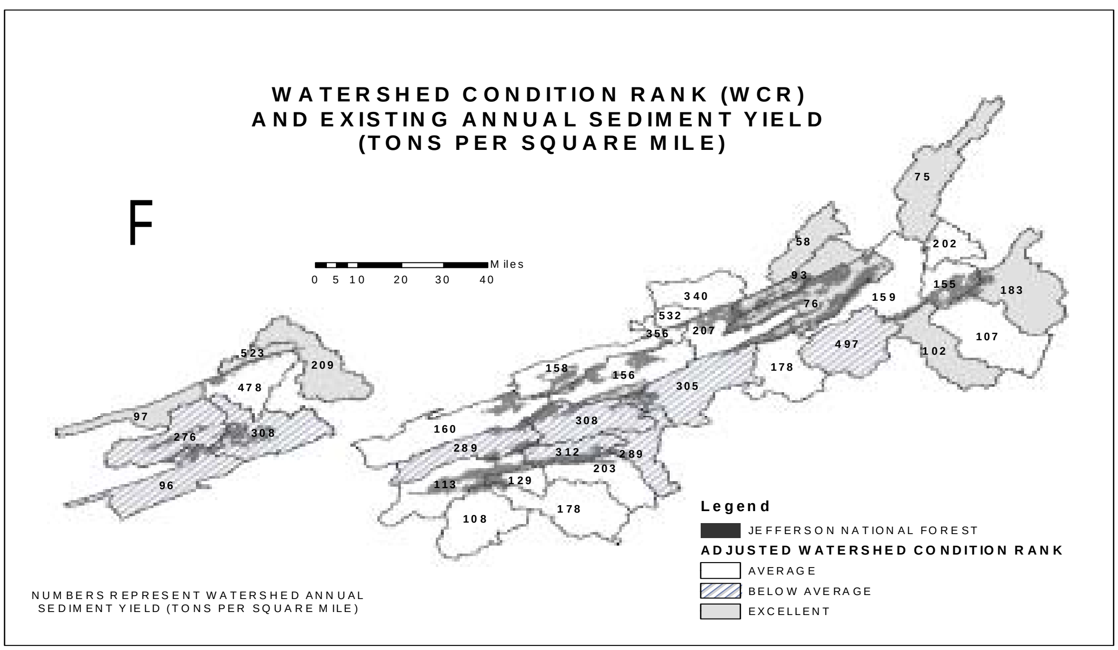

Figure 3-2. Watershed Condition Rank (WCR) and Existing Annual Sediment Yield (tons per square mile per year)

existing (current) sediment rates, but also the added effects of land uses in the watersheds proposed in the various alternatives over the 50-year planning horizon.

The GIS sediment model at this scale of analysis is not a perfect representation of annual sediment yields. The modeled background annual sediment yields for all fifth code HUC watersheds are lower than published data by Patric and others (1984), Guy (1969), and Kirshner and others (2001). This is because of the following reasons. First, the model considers only surface erosion and does not factor in the infrequent natural catastrophic erosion events that dominate the long-term sediment yield. Secondly, the model utilizes Roehl's (1962) sediment delivery coefficient, which has considerable associated variability. Lastly, the model does not consider that some HUC watersheds are not true topographic watersheds, but rather segments with drainage areas above them.

Likewise, the GIS sediment model is not a perfect representation of current or future annual sediment yields. This is because of the following reasons. First, for land uses and soil disturbing activities except roads, the model utilizes Roehl's (1962) sediment delivery coefficient, which has considerable associated variability. Secondly, the model does not consider the distance between soil disturbing activities and stream channels, and thus does not consider the riparian corridor widths as sediment buffers. Thirdly, the model does not evaluate the effect of dams as sediment traps on the Levisa, New, Roanoke, and other rivers. Lastly, the model does not consider that some HUC watersheds are not true topographic watersheds, but rather segments with drainage areas above them.

Therefore, the results of the model should not be interpreted as absolute values, but rather as a "coarse filter." As such, they provide a useful tool to evaluate the magnitude of sediment increases not only from Forest Service related activities but also from activities on private and other public lands within the watershed, and to compare the effects of alternatives on sediment production over time.

Outputs from the sediment model included both estimates of sediment yields and an overall ranking of the condition of each watershed. Current (existing) sediment yields from the 36 fifth code HUC watersheds are displayed in Figure 3-2.

WATERSHED CONDITION RANK

Watershed Condition Rank (WCR) is used to characterize the condition of 5th level watersheds with respect to current sediment yields. The procedure for determining WCR is contained in the process paper *Sediment Yields and Cumulative Effects for Water Quality and Associated Beneficial Uses*.

In order to establish WCR's, the current sediment average annual yield is determined and expressed as a percent above the baseline condition. Initial watershed health is determined by using the relative abundance of locally adapted species with respect to sediment increases. 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 (E), average (A), and below average (BA). In general, watersheds with the lowest annual sediment yields were ranked as excellent. Those with higher annual sediment yields ranked as average or below average. The exceptions were some watershed within the Cumberland Plateau and Piedmont physiographic provinces where condition thresholds allowed higher sediment yields.

WATERSHED ASSESSMENT AND EVALUATION

The existing and future conditions of watersheds under the various alternatives were analyzed through a two-part watershed analysis, which included resource assessment and management prescription (Reid 1998).

First a resource assessment was conducted using the Eastern Watershed Assessment Protocol (EWAP). Fifth code HUC watersheds were evaluated in a GIS environment using information including, but not limited to: Virginia Department of Environmental Quality 303d report (impaired waters); Virginia Department of Conservation and Recreation 305b report (non-point source pollution); Virginia Department of Game and Inland Fisheries collection records; Virginia Division of Natural Resources collection records and reports; local knowledge of forest recovery from past conditions; local knowledge of current watershed problems; studies conducted by other Federal and State agencies; macroinvertebrate, stream habitat, and water chemistry information; and geographic information system layers of land use, point source, road and strip mine locations. This resource assessment provided the source of information used to evaluate the condition of each watershed.

Secondly, the condition of each watershed was evaluated through many meetings and discussions, which included not only multi-agency resource professionals, but members of the public as well. These occurred during Interdisciplinary Team meetings in 2001, which are documented in meeting notes published on the Internet: http://www.southernregion.fs.fed.us/gwj/lrmp/idt.htm.

Other individual watershed factors as well as combination of factors were considered and evaluated to determine the present condition of each watershed based on cumulative past and ongoing activities within it.

VALIDATING THE WATERSHED CONDITION RANK USING THE WATERSHED ASSESSMENT AND EVALUATION

The wealth of information in the Watershed Assessment and Evaluation provided a means to validate or modify the initial WCR for each watershed. The WCR ratings are developed by modeling sediment yields and evaluating them against a predicted change in percent endemic fish species. Table 3-8 displays the initial WCR for each watershed. For most of the watersheds the initial WCR rating agrees with the resource assessment results and are therefore presumed to be valid measures of existing watershed condition relative to sediment. However, the following four watersheds had initial WCR rankings that were not consistent with the resource assessment results.

(1.) Cripple Creek watershed (05050001070) had an initial WCR model outcome of "average." Information from the watershed assessment and evaluation process does not agree and indicates that a rating of averge for Cripple Creek is too high. This watershed has been identified as a priority watershed with impaired stream segments. The WCR has therefore been adjusted to "below average" (BA).

(2.) The Clinch – Guest watershed (06010205040) had an initial WCR model outcome of "average." Again, information from the watershed assessment and evaluation process does not agree and indicates a lower rating is warranted. The Clinch – Guest is identified as a priority watershed with impaired stream segments. Additionally, the *Clinch and Powell Valley Watershed Ecological Risk Assessment* (US EPA, 2002) identifies sediment as a stressor affecting native mussels and native fish in this watershed. Accordingly, the Clinch – Guest watershed has been assigned a modified WCR of "below average" (BA).

(3.) The lower Clinch watershed (06010205050) had an initial WCR model outcome of "excellent." Information from the watershed assessment and evaluation process does not agree and indicates that a rating of excellent for the lower Clinch River may be too high. The model treats this HUC area as if it were a topographic watershed and does not take into account the drainage areas upstream including the Clinch –Guest with its mine-related impacts. Also, the *Clinch and Powell Valley Watershed Ecological Risk Assessment*

(US EPA, 2002) identifies sediment as a stressor affecting native mussels and native fish in this watershed. Therefore, the lower Clinch watershed has been assigned a modified WCR of "below average" (BA).

(4.) The Powell River watershed (06010206010) has a current WCR model outcome of "excellent." Information from the watershed assessment and evaluation procedure indicates this rating is too high. The watershed includes stream reaches that have been identified as impaired and are included on Virginia's 303d list, and the *Clinch and Powell Valley Watershed Ecological Risk Assessment* (US EPA, 2002) identifies sediment as a stressor affecting native mussels and native fish in this watershed. Based on the weight of evidence, the Powell River watershed has been assigned a modified WCR of "below average" (BA).

Once WCR rankings of existing conditions were adjusted and finalized, the prescriptions, goals, objectives, and outputs of the various alternatives were modeled. Some alternatives focused management on riparian, aquatic, and healthy watershed needs. They were designed to not only minimize adverse impacts to aquatic and riparian areas, but to maintain them as healthy, functioning systems.

See Table 3-8 for the current WCRs as adjusted.

Direct and Indirect Effects on Sediment

The following discussion provides some background information regarding the environmental effects common to soil and water resources from management activities. Any activity that disturbs the land surface, decreases cover or alters vegetation can affect soils, water yield and water quality. The primary management activities that could affect the soil resource, water yield, and water quality are:

- Roads and Trails
- Vegetation Management
- Mineral Exploration and Development
- Fire Management

Roads and Trails. Roads and trails directly and indirectly affect water by increasing sedimentation and concentrating runoff. 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.

Vegetation Management. Vegetation management activities that typically affect soil and water are timber harvesting and associated landing 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.

Mineral Exploration and Development. Mineral exploration and development can affect soil and water by increasing erosion and sedimentation, soil compaction, and water yield. In many cases soil productivity is reduced and sediment can affect water quality. The potential seepage or spillage of toxic substances from mining facilities or disposal areas may also pose a threat to water quality.

Fire Management. Prescribed burning directly affects soil and water by removing a portion of the vegetative cover, which exposes soil to erosion. Control lines also expose mineral soil. These factors can reduce soil productivity and increase stream sedimentation. The magnitude of effect varies widely depending on the soils, topography and the intensity of burn.

A direct effect of implementation of the various alternatives is an increase in sediment yield from the watersheds as a result of activity-related soil disturbance. Table 3-9 displays the percent increase in sediment over current values for Forest Service activities. The percent increase represents the change for an average or normal year. The direct increases for all alternatives average less than one percent, with the greatest increases for individual watersheds less than 5 percent. As shown in Table 3-9, the greatest increase under Alternative I is 3.93 percent and occurs in watershed 02080201080, Craig Creek tributary to the Upper James River. The greatest increase for any watershed in all alternatives is the 4.74 percent increase for watershed 05050002010 Sinking Creek / Stony Creek in Alternative D.

The question that must be answered for this effect is whether sediment from the proposed Forest Service activity will produce a detectable change in the sediment load of the rivers or in the character of the streambed. There is a great deal of variability in the sediment yield from year to year, which is termed "interannual variability." In part, this is because sediment yield is much greater during high runoff years with more stormflow to erode and transport sediment. Conversely, sediment yield is much less during drought years when high flows may be less than bankfull. However, interannual variability is a function of much more than the weather.

Data from the USGS gage on the Clinch River at Speers Ferry provides an expression of the variability of annual sediment yield. For the 62 years with flow and sediment data, each year's percent difference from the long-term mean ranges from plus 143 percent to minus 100 percent. A change of annual sediment yield of plus or minus 52 percent represents one standard deviation from the long-term mean. This value is also termed the coefficient of variation. According to Bunte and MacDonald (1999), "very few records of annual sediment yield have a coefficient of variation of less than 50%, an most values are closer to 100%." Therefore, the data from the Clinch provide a good but conservative estimate of the coefficient of variation for the other watershed systems evaluated in the sediment model. Figure 3-3 displays the interannual sediment variability for the Clinch River at Speers Ferry.

The interannual variability of sediment determines the magnitude of change that can be detected during a given time period. Bunte and MacDonald (1999) state that the number of years of monitoring needed to detect a sediment increase of "z" percent at the 95% confidence interval is given by the formula:

Number of sampling years ={(1.96/"z") x (coefficient of variation)}^{2}

This responds to the question of whether there will be a detectable change in the sediment load of any of the rivers considered in this analysis. For example, it would take at least 415 years of monitoring data to detect a 5 percent increase in sediment in the Clinch River or other in rivers in Virginia. Because all modeled sediment increases from Forest Service activities for all alternatives are less than 5 percent, for all practical purposes the sediment increase would not be detectable. For a sediment increase to be detectable, it would have to exceed the range of interannual variability for the watershed. According to the formula, it would require four years of annual sediment data to detect an increase of 52 percent at the 95% confidence interval, and one year to detect an increase of 100 percent. Sediment increases would have to exceed the interannual variability before they become reasonably detectable.

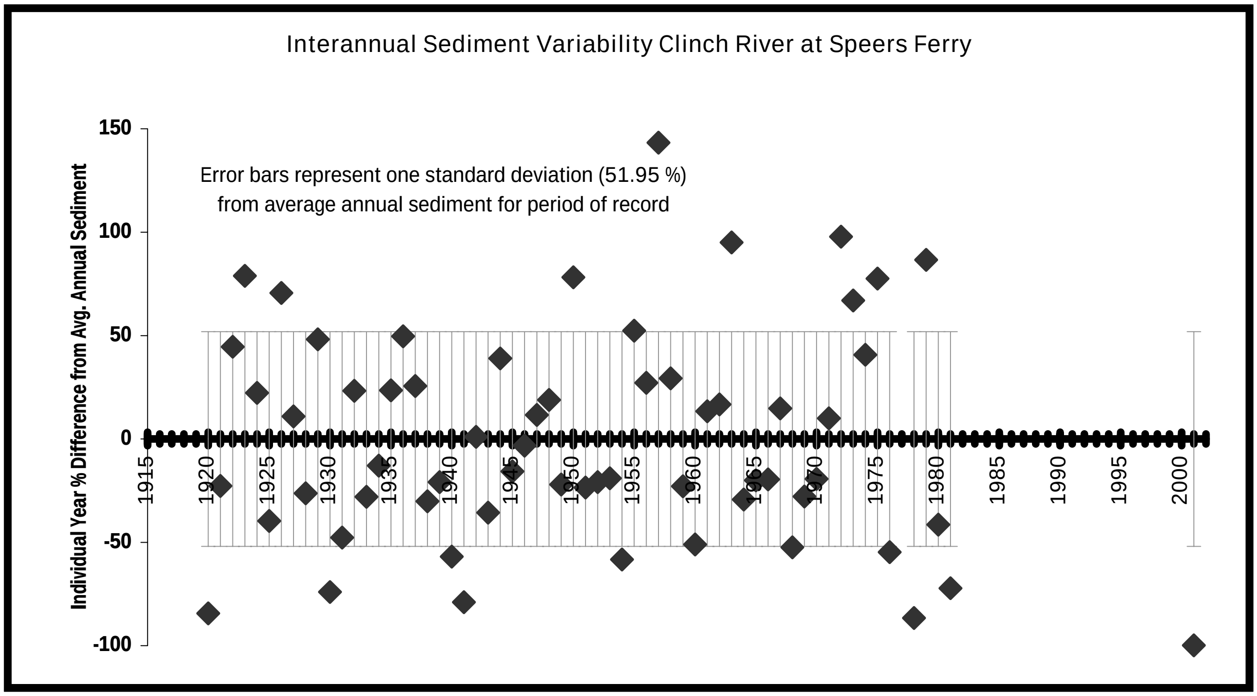

Figure 3-3. Interannual Sediment Variability Clinch River at Speers Ferry

Cumulative Effects on Sediment

Cumulative effects include those related to changes in the pattern of land use within the watersheds. Activities within each watershed and outside of the National Forest were included in the sediment model. Future activities were modeled by projecting current rates of land use change and urban growth. Table 3-10 displays the combined sediment increases from activity on both private and National Forest land. The average combined increase is less than 4 percent. Only one watershed has combined increases greater than 8 percent. That is the Poor Fork of the Cumberland with a modeled combined increase of 14 percent. Applying the evaluation presented above, it would take at least 162 years of data to detect an 8 percent increase in sediment, and 53 years of data to detect a 14 percent increase. For all watersheds under consideration, the cumulative effects of the sediment increases are well within the range of interannual variability and for all practical purposes are not detectable.

Direct, Indirect, and Cumulative Effects on Watershed Conditions

The WCR sediment model evaluated baseline sediment, current sediment yield, and increases from activities on both National Forest and private lands for five decades into the future. The increases are interpreted in the context of effects on endemic fish. Model outputs for current WCR were validated as described above using the Watershed Assessment and Evaluation procedure. Table 3-8 displays the projected WCR for each watershed for each alternative for the first decade. The only change in WCR in any of the watersheds and alternatives is for HUC 05050002010; Sinking Creek /Stony Creek tributary to the New River. Closer examination reveals that although the modeled

(Continued on page 42)

Table 3-8. Watershed Condition Rank by Alternative, First Decade

Fifth Code HUC Watershed	INITIAL WCR	ADJUSTED WCR	WCR BY ALTERNATIVE A	B	D	E	F	G	I
02080201020	E	E	E	E	E	E	E	E	E
02080201030	E	E	E	E	E	E	E	E	E
02080201060	E	E	E	E	E	E	E	E	E
02080201070	A	A	A	A	A	A	A	A	A
02080201080	E	E	E	E	E	E	E	E	E
02080201090	A	A	A	A	A	A	A	A	A
02080202050	A	A	A	A	A	A	A	A	A
02080203010	E	E	E	E	E	E	E	E	E
03010101010	A	A	A	A	A	A	A	A	A
03010101020	BA	BA	BA	BA	BA	BA	BA	BA	BA
03010101070	E	E	E	E	E	E	E	E	E
03010101080	A	A	A	A	A	A	A	A	A
05050001010	A	A	A	A	A	A	A	A	A
05050001030	A	A	A	A	A	A	A	A	A
05050001040	A	A	A	A	A	A	A	A	A
05050001050	A	A	A	A	A	A	A	A	A
05050001060	BA	BA	BA	BA	BA	BA	BA	BA	BA
05050001070	A	BA	BA	BA	BA	BA	BA	BA	BA
05050001080	BA	BA	BA	BA	BA	BA	BA	BA	BA
05050001100	BA	BA	BA	BA	BA	BA	BA	BA	BA
05050002010	A	A	A	A	BA	A	A	A	A
05050002020	A	A	A	A	A	A	A	A	A
05050002030	A	A	A	A	A	A	A	A	A
05050002040	A	A	A	A	A	A	A	A	A
05050002070	A	A	A	A	A	A	A	A	A
05050002100	A	A	A	A	A	A	A	A	A
05070202030	E	E	E	E	E	E	E	E	E
05070202050	A	A	A	A	A	A	A	A	A
05070202060	E	E	E	E	E	E	E	E	E
05130101010	E	E	E	E	E	E	E	E	E
06010101010	A	A	A	A	A	A	A	A	A
06010102010	A	A	A	A	A	A	A	A	A
06010102020	BA	BA	BA	BA	BA	BA	BA	BA	BA
06010205040	A	BA	BA	BA	BA	BA	BA	BA	BA
06010205050	E	BA	BA	BA	BA	BA	BA	BA	BA
06010206010	E	BA	BA	BA	BA	BA	BA	BA	BA

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Table 3-9. Percent Increase Over Current Sediment Yields due to Projected Forest Service Activity during the First Decade

Fifth Code HUC Watershed	Percent Increase by Alternative						
	A	B	D	E	F	G	I
02080201020	0.00	0.00	0.00	0.00	0.00	0.00	0.08
02080201030	1.61	0.85	1.93	0.66	1.01	0.24	1.91
02080201060	0.00	0.00	0.00	0.00	0.00	0.00	0.00
02080201070	0.23	0.19	0.35	0.13	0.25	0.04	0.25
02080201080	4.36	3.43	4.44	1.67	2.52	0.66	3.93
02080201090	1.19	0.93	2.13	0.45	1.72	0.20	2.12
02080202050	0.12	0.05	0.16	0.05	0.06	0.02	0.06
02080203010	0.11	0.13	0.21	0.04	0.17	0.01	0.14
03010101010	0.05	0.02	0.05	0.01	0.02	0.01	0.02
03010101020	0.01	0.00	0.01	0.00	0.01	0.00	0.01
03010101070	0.08	0.05	0.13	0.03	0.13	0.01	0.09
03010101080	0.07	0.04	0.14	0.03	0.20	0.00	0.09
05050001010	0.11	0.06	0.23	0.04	0.23	0.01	0.13
05050001030	0.05	0.04	0.13	0.02	0.14	0.00	0.07
05050001040	0.22	0.16	0.34	0.08	0.26	0.01	0.30
05050001050	0.97	0.42	3.33	0.38	2.76	0.05	1.39
05050001060	0.06	0.03	0.10	0.02	0.09	0.00	0.08
05050001070	0.47	0.34	0.87	0.17	0.88	0.03	0.60
05050001080	0.39	0.78	0.50	0.14	0.19	0.27	0.56
05050001100	0.12	0.09	0.15	0.06	0.10	0.03	0.11
05050002010	0.69	0.38	4.74	0.29	0.41	0.10	0.46
05050002020	0.77	0.82	1.05	0.39	0.63	0.43	0.71
05050002030	0.53	0.36	0.95	0.26	0.40	0.18	0.43
05050002040	0.36	0.11	0.29	0.09	0.12	0.03	0.14
05050002070	0.02	0.01	0.02	0.02	0.02	0.00	0.02
05050002100	0.01	0.00	0.00	0.00	0.00	0.00	0.01
05070202030	0.02	0.02	0.05	0.01	0.05	0.00	0.01
05070202050	0.15	0.14	0.29	0.09	0.32	0.02	0.09
05070202060	0.01	0.00	0.01	0.00	0.01	0.00	0.00
05130101010	0.04	0.04	0.09	0.03	0.10	0.01	0.02
06010101010	0.31	0.38	0.40	0.14	0.21	0.05	0.21
06010102010	1.15	0.76	3.05	0.44	1.57	0.07	1.40
06010102020	0.22	0.13	0.36	0.09	0.22	0.03	0.21
06010205040	0.35	0.35	0.66	0.21	0.74	0.04	0.18
06010205050	0.67	0.85	1.10	0.43	1.00	0.07	0.87
06010206010	0.20	0.23	0.38	0.12	0.41	0.02	0.12
Average	**0.44**	**0.34**	**0.80**	**0.18**	**0.47**	**0.07**	**0.47**
Maximum	**4.36**	**3.43**	**4.74**	**1.67**	**2.76**	**0.66**	**3.93**

Table 3-10. Percent Increase Over Current Sediment Yields from Projected Private and Forest Service Activity during the First Decade

Fifth Code HUC Watershed	Percent Increase by Alternative						
	A	B	D	E	F	G	I
02080201020	5.97	5.97	5.97	5.97	5.97	5.97	6.05
02080201030	6.11	5.35	6.43	5.16	5.51	4.74	6.41
02080201060	7.17	7.17	7.17	7.17	7.17	7.17	7.17
02080201070	2.59	2.55	2.72	2.49	2.62	2.40	2.61
02080201080	6.16	5.24	6.24	3.47	4.32	2.46	5.73
02080201090	3.67	3.41	4.60	2.93	4.19	2.67	4.60
02080202050	2.80	2.73	2.84	2.72	2.74	2.69	2.74
02080203010	2.55	2.57	2.65	2.49	2.62	2.45	2.58
03010101010	3.70	3.67	3.70	3.66	3.67	3.66	3.67
03010101020	1.65	1.64	1.65	1.64	1.65	1.64	1.65
03010101070	2.27	2.24	2.33	2.23	2.33	2.20	2.29
03010101080	1.84	1.81	1.91	1.80	1.97	1.78	1.86
05050001010	7.05	7.00	7.17	6.98	7.18	6.95	7.07
05050001030	2.35	2.34	2.43	2.32	2.44	2.30	2.37
05050001040	2.30	2.24	2.43	2.16	2.34	2.10	2.39
05050001050	5.68	5.13	8.04	5.09	7.47	4.76	6.10
05050001060	1.38	1.35	1.42	1.34	1.40	1.32	1.39
05050001070	1.23	1.10	1.63	0.93	1.63	0.78	1.36
05050001080	1.10	1.49	1.21	0.85	0.90	0.98	1.27
05050001100	1.18	1.16	1.22	1.13	1.17	1.10	1.17
05050002010	2.37	2.06	6.43	1.98	2.10	1.79	2.15
05050002020	2.39	2.43	2.66	2.00	2.24	2.04	2.32
05050002030	3.50	3.32	3.91	3.23	3.37	3.15	3.39
05050002040	3.07	2.81	2.99	2.80	2.83	2.74	2.84
05050002070	1.17	1.16	1.17	1.17	1.17	1.15	1.17
05050002100	1.41	1.40	1.40	1.40	1.40	1.40	1.41
05070202030	5.66	5.66	5.69	5.65	5.69	5.64	5.65
05070202050	2.54	2.53	2.69	2.49	2.72	2.41	2.48
05070202060	4.32	4.32	4.32	4.31	4.32	4.31	4.31
05130101010	13.26	13.26	13.31	13.24	13.32	13.22	13.23
06010101010	3.00	3.07	3.09	2.82	2.90	2.74	2.90
06010102010	4.31	3.91	6.21	3.59	4.72	3.22	4.55
06010102020	1.26	1.17	1.40	1.13	1.26	1.07	1.25
06010205040	2.70	2.70	3.02	2.56	3.10	2.39	2.53
06010205050	6.44	6.62	6.87	6.20	6.77	5.84	6.64
06010206010	3.38	3.41	3.57	3.30	3.60	3.21	3.30

Where: E = excellent; A = average; and BA = below average

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sediment increase is very small (4.74 percent from Forest Service activities), it very slightly exceeds an index class threshold. As discussed above, the sediment model does not have the capability to evaluate the effects of the Riparian Corridor and the Standards associated with it. In reality, the sediment increase would be much smaller. The WCR was modeled for each alternative for five decades. Other than the slight change in one watershed discussed above, the data showed no change in the WCR and therefore no cumulative watershed effect for five decades into the future.

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The biological environment is the living portion of the environment and includes trees, plants, animals, fish, mollusks, crustaceans, insects, etc. This section begins with a description of the major forest communities of the JNF, followed by the rare communities of the Forest. These communities are then further discussed in terms of wildlife habitat including successional forests, old growth, permanent openings, interior habitats, riparian habitats, snags, dens and downed wood. Discussion of terrestrial and aquatic species are presented in four sections: demand species; migratory species; aquatic species; and threatened, endangered, sensitive, and locally rare species. The discussion of terrestrial and aquatic species viability evaluations concludes this section of Chapter 3.

MANAGEMENT INDICATOR SPECIES

National Forest Management Act regulations, adopted in 1982, require selection of management indicator species (MIS) during development of forest plans (36 CFR 219.19 (a)). Reasons for their selection must be stated. This section describes the MIS selected for the revised Land and Resource Management Plan and the conditions they are to represent. A more complete documentation of the process is contained in the MIS Process Selection white paper.

Management indicator species (MIS) are to be selected “because their population changes are believed to indicate the effects of management activities” (36 CFR 219 (a) (1)). They are to be used during planning to help compare effects of alternatives (36 CFR 219.19(a)(2)), and as a focus for monitoring (36 CFR 219.19(a)(6)). Where appropriate, MIS shall represent the following groups of species (36 CFR 219 (a)(1)):

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

Since adoption of these regulations, the management indicator species concept has been reviewed and critiqued by the scientific community (Caro and O’Doherty 1999, Simberloff 1998, Noss 1990, Landres et al. 1988, and Weaver 1995). These reviews identify proper uses and limitations of the indicator species concept. They generally caution against overreaching in use of indicator species, especially when making inferences about ecological conditions or status of other species within a community. Caution is needed because many different factors may affect populations of each species within a community, and each species’ ecological niche within a community is unique.

To reflect this current scientific understanding while meeting the letter and spirit of regulations, we have made great effort to clearly define the legitimate uses and limitations of each selected MIS. The MIS process is but one tool used to develop management strategies and monitoring programs designed to meet NFMA requirements related to diversity of plant and animal communities. Other elements used for comprehensive planning for plant and animal diversity include: objectives and standards for maintenance and restoration of desired ecological conditions based on knowledge of overall ecosystem structure and function; biological evaluations and assessments at both the forest plan and site-specific project levels; and evaluation of risk to species of viability concern at the forest plan level. Other elements important to monitoring effects of plan implementation on plant and animal diversity include, where appropriate, monitoring of key ecological conditions, levels of management activities important to restoration and maintenance of community diversity, species assemblages (birds, bats, fish, etc.), harvest levels of game and other demand species, and populations of threatened, endangered, and sensitive species.

PEAKS OF OTTER SALAMANDER (***Plethodon hubrichti***). The Peaks of Otter salamander is an appropriate MIS because it is a Sensitive species and a narrow endemic that occurs almost entirely on the Jefferson National Forest and the Blue Ridge Parkway. This species requires mature, moist hardwood forest. While a significant portion of the range is dedicated to non-management uses, timber harvest is allowed in about 60% of the range. Population comparisons between managed and non-managed areas can indicate the effects of timber management on this species. This MIS is discussed under the Regional Forester's Sensitive Species section of this Chapter.

PILEATED WOODPECKER (***Dryocopus pileatus)***. The pileated woodpecker was selected as an MIS because it requires large snags for nesting and feeding. The occurrence of this species may be correlated with forested habitats containing abundant large dead trees and fallen logs (Hamel 1992), which also are used by other woodpeckers, owls, and numerous other birds, mammals, and amphibians. This species is selected to help indicate the effects of management activities on the availability of forests with desired abundance of snags. 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. It also occurs at relatively low densities, reducing the number of data points available for trend estimates. Local analysis would therefore be limited; analysis in regional trends across national forests would provide more analytical power. Population monitoring would be combined with information on forest age-class distribution and snag densities to provide a full picture of management effects on this species and other snag-dependent wildlife. This MIS is discussed under the Snags, Dens, and Down Wood section of this Chapter.

OVENBIRD (***Seiurus aurocapillus)***. The ovenbird was selected as a MIS because it is associated with forest interior conditions. It is strongly associated with mature forest interior habitats (Hamel 1992, Crawford et al. 1981), and it is also common enough to be feasibly monitored for trends. Long-term monitoring of this species has resulted in some of the most robust data sets of any of the interior bird species surveyed on the forest. This species is selected to help indicate the effects of management on the availability of suitable mature forest interior habitats. Other elements, such as landscape analysis of forest fragmentation using remote sensing data, would supplement information received from monitoring this species. This MIS is discussed under the Interior Forest section of this Chapter.

CHESTNUT-SIDED WARBLER (***Dendroica pensylvanica***). The chestnut-sided warbler was selected as the most appropriate MIS for high-elevation early-successional habitats because of its strong association with these habitats, and because its populations should be responsive to forest management efforts to create and sustain such habitats. Also, the

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chestnut-sided warbler is effectively monitored using established protocols. This MIS is discussed under the Successional Forest section of this Chapter.

ACADIAN FLYCATCHER (***Empidonax virescens***). The Acadian flycatcher was selected as the most appropriate species to indicate management-induced changes to mature riparian forests. It is highly associated with mature deciduous forests along streams and bottomland hardwoods, which it uses for feeding and reproduction (Hamel 1992). It is also effectively monitored using proven, consistent protocols. It is relatively common in these habitats, providing enough data for evaluation. This MIS is discussed under the Riparian Forest section of this Chapter.

BLACK BEAR (***Ursus americanus***), WILD TURKEY (***Meleagris gallopavo***), and WHITE-TAILED DEER (***Odocoileus virginianus***). These species were retained as MIS because they are species of high demand in Virginia. The National Forest provides key habitat attributes for bear in Virginia including remoteness and the availability of den trees and mast. Many Virginia hunters must utilize public lands to pursue deer and turkey, thus management activities will influence their success and experience. The Virginia Department of Game and Inland Fisheries tracks annual harvest for these species; harvest data is identified by county and land ownership status (public versus private). This MIS is discussed under the Demand Species section of this Chapter.

HOODED WARBLER (***Wilsonia citrina***). The hooded warbler was selected as an MIS for mid- to late-successional mesic deciduous forests. The hooded warbler is heavily associated with moist deciduous forests with fairly dense understories, where it breeds and feeds (Hamel 1992, Crawford et al. 1981). Management opportunities exist to increase the structural diversity of closed canopied habitats in this type to favor species, such as the hooded warbler, that optimize their life history in forests with canopy gaps and patches of dense understory. This species is deemed appropriate for helping to indicate the availability of mid- and late-successional mesic deciduous habitats and the efficiency of management intended to favor its habitat.

Because of their wide distribution across moisture gradients, mid- and late-successional oak and oak-pine forests support a wide variety of species. Hooded warblers, selected as MIS for mid- and late-successional mesic deciduous forests adequately represent the mesic oak forest communities. This species is expected to respond positively to management actions (including thinning and moderate frequency burning) that are designed to stimulate advanced oak regeneration and perpetuation of the forest type on these mesic sites. This MIS is discussed under the Oak and Oak-Pine Forest section of this Chapter.

SCARLET TANAGER (***Piranga olivacea***). Drier oak forests support a slightly different mix of species due to their more open condition. To represent this upland oak community, the scarlet tanager is selected as an MIS. This species is most abundant in upland mature forest (Hamel 1992). Trends for these species will be evaluated along with trends in total acres, age-class distribution, and level of restoration and maintenance activities in this forest type to provide a more complete picture of effects of management on this community. This MIS is discussed under the Oak and Oak-Pine Forest section of this Chapter.

PINE WARBLER (***Dendroica pinus***). Pine forests have been in serious recent decline on the national forest as a result of southern pine beetle epidemics and lack of fire needed to maintain their dominance. Therefore, they will be the focus of ecological restoration and maintenance on some portions of the national forest. The pine warbler is closely associated with pine and pine-oak forests, generally occurring only where some pine component is present. It therefore is an appropriate indicator of the effects of management in restoring and maintaining pine forests. It should be noted, however, that this species does not discriminate as to the condition of pine stands relative to mid and understory, and so would indicate little more than the presence of pine. Other bird species that may be associated with desired fire-maintained conditions were not deemed sufficiently likely to be present to be appropriate MIS. Understory plant species also were considered and found to be too universal in association to be appropriate MIS. Therefore, pine warbler and various habitat-based elements, such as amount and effectiveness of prescribed burning, will be used to indicate effects of management on species associated with this community. This MIS is discussed under the Pine and Pine-Oak Forest section of this Chapter.

EASTERN TOWHEE (***Pipilo erythrophthalmus***). The eastern towhee was selected as the most appropriate MIS to represent early-successional forests. Eastern towhees are shrubland nesting birds that require thickets or brushy places on the ground or in shrubs or saplings to 5 feet high for nesting. Providing a sustained flow of regenerating forests is necessary to support populations of this species. This MIS is discussed under the Successional Forests section of this Chapter.

WILD TROUT. Acid deposition is a major ecological concern due of its effects on forest streams and the communities they support. Wild trout are an appropriate MIS in such streams, due to their sensitivity to changes in stream pH and their importance as a game species. Wild trout are therefore selected as MIS to be monitored and evaluated. This MIS is discussed under the Fisheries and Aquatic Habitat section of this Chapter.

Direct, Indirect and Cumulative Effects

In summary, 13 species have been selected as management indicator species for the revised forest plan. They will be used to assess effects of alternatives and to help monitor effects of implementing the selected alternative.

Within specific major forest communities and terrestrial habitats there is discussion of individual MIS and their expected response to each alternative. Viable populations of management indicator species are expected within all alternatives, but the mix of habitat components, by Alternative, will influence the degree to which increases or decreases are expected for each MIS.

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EASTERN HEMLOCK AND WHITE PINE FORESTS

Eastern hemlock and white pine forests are broadly defined to include those forested communities that are either dominated or co-dominated by eastern hemlock (*Tsuga canadensis*) or eastern white pine (*Pinus strobus*) in the canopy. These forest types are the predominant components of the Conifer-Northern Hardwood community type described in the regional old growth guidance (USDA Forest Service 1997). For the purposes of this analysis, forests with a significant component of eastern hemlock are classified as hemlock forests, even where white pine may be dominant (CISC types 4, 5, 8). White pine forests include all other forests where white pine is dominant (CISC types 3, 9, 10). This division puts priority on the presence of hemlock as a key habitat component.

Eastern hemlock forests typically occur on acidic soils and often have a dense shrub layer composed of ericaceous species. These communities are typically low in herbaceous diversity, but may support rich bryophyte communities. White pine forests occupy similar

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sites but also may occur on drier locations, particularly in areas where fire has been suppressed. White pine forests have also been artificially created as timber plantations.

The combination of a largely evergreen canopy and a dense midstory in naturally occurring hemlock and white pine forests provide for a variety of benefits, including shading and cooling of riparian systems, thermal cover for wildlife, and nesting and foraging habitat for several species of neotropical migrant birds dependant upon the layered canopy structure and understory thickets (Rhea and Watson 1994). There is some evidence that hemlock-white pine forests provide necessary habitat components for the long-term conservation of red crossbills (Dickson 2001). Eastern hemlock forests may also be important refugia for species typically adapted to higher elevations. Dickson (2000) states that red-breasted nuthatches, winter wrens, and golden-crowned kinglets are found in late successional hemlock forests down to elevations of 2,000 feet, and several species of rare bryophytes that are known to occur primarily within the spruce/fir zone are also found at lower elevations in humid gorges often under a canopy that includes eastern hemlock (Hicks 1992).

In 1996, the Southern Appalachian Assessment (SAMAB 1996) estimated that there were 617,687 acres of “White Pine-Hemlock Forests” across all land ownerships in the southern Appalachians, representing 2.5% of the total land base. This figure represents data collected from FIA, CISC, and LANDSAT imagery. The current amount and distribution of mature eastern hemlock forests is threatened by the recent emergence of the hemlock woolly adelgid in the southern Appalachians. First identified in the eastern United States near Richmond, VA in 1924, this non-native invasive pest has recently spread into the southern Appalachians and threatens to spread throughout the range, causing mortality within five years after initial infestation (SAMAB 1996).

Table 3-11 displays the acres and percent of eastern hemlock and white pine forests by seral stage across the Jefferson National Forest.

On the Jefferson National Forest, eastern hemlock forests are found primarily in association with riparian systems, high elevations, and north facing coves. Eastern hemlock forests occur on approximately 4,000 acres, or less than 1% of all forested acres on the Jefferson National Forest. White pine forests are more abundant and can be found on drier sites on all aspects. Years of fire suppression have allowed individual hemlocks and white pine to creep upslope onto more xeric slopes and ridges where they would not likely exist under a natural fire regime. There are currently approximately 17,300 acres of white pine forest types on the Jefferson National Forest, about 5,000 acres (or 30%) of which originated as plantations.

While all Districts contain some eastern hemlock and/or white pine forests, the largest concentration of this community type is in the central portion of the forest (New River Valley District and Mount Rogers). The community type is relatively abundant and well

Table 3-11. Eastern Hemlock and White Pine Forests by Current Successional Stage

Eastern Hemlock Successional Stage	**Acres**	**Percent**	**White Pine Successional Stage**	**Acres**	**Percent**
Early Successional	50	1%	Early Successional	1,200	7%
Sapling/Pole	80	2%	Sapling/Pole	8,700	50%
Mid- Successional	1,300	32%	Mid- Successional	4,500	26%
Late-Successional	2,600	65%	Late-Successional	2,900	17%
TOTAL	**4,030**		**TOTAL**	**17,300**	
Percent of JNF Acres		**<1%**	**Percent of JNF Acres**		**2%**

distributed in this area. The Northern portion of the forest (New Castle and Glenwood) contains fewer acres of the community type, which is evenly distributed on the New Castle but concentrated in the north central portion of the Glenwood. The Clinch Ranger District has very little of this community type.

MANAGEMENT INDICATORS

Two key habitat variables are selected as management indicators to monitor the condition of eastern hemlock and white pine forests: 1) the potential for the use of prescribed fire; and 2) the potential use of vegetation management in this community type. Because the main factor that may cause reduced abundance in hemlock forests and associated species is the hemlock woolly adelgid rather than management, it is not meaningful to select management indicator species for this community type.

Direct and Indirect Effects

ABUNDANCE

With a renewed emphasis of introducing fire onto the landscape in areas where natural fire may have played a role in shaping historic vegetative patterns, it is likely that eastern hemlock and white pine distributions will shrink from areas where it has been able to become established in the absence of fire. Table 3-12 shows the proportion of eastern hemlock and white pine forests by prescribed fire level by alternative. These figures show that Alternative D has the highest potential for reducing this community type through the use of prescribed fire, with 88% of this community type in a moderate or high prescribed fire level. Alternatives B, F, I, and A, in that order, have slightly decreasing percentages of the community type in a high or moderate prescribed fire level, ranging from 85% to 83%. Eastern hemlock and white pine can be expected to be reduced under these alternatives as well, perhaps only slightly less than Alternative D. Finally, Alternatives E and G result in the least potential for prescribed fire to reduce this community type. But the potential is still relatively high at 77% and 76%, respectively, of the community type in a moderate- to high-prescribed fire level. Hemlock forest types would be less likely to be impacted by prescribed fire due to their strong association with riparian areas, which may be eliminated from a prescribed fire or where fire is expected to burn less intensely.

Table 3-12. Percent of Existing Eastern Hemlock and White Pine Forests in Each Prescribed Fire Level by Alternative

	Prescribed Fire Level			
	None	Low	Medium	High
Alternative A	8	9	50	33
Alternative B	7	8	33	52
Alternative D	5	7	22	66
Alternative E	6	17	71	6
Alternative F	7	9	37	47
Alternative G	5	19	50	26
Alternative I	3	13	51	33

Conversely, vegetation management can be used to promote white pine forests, especially in those areas where the type is less abundant. Hemlock is generally not managed through vegetation manipulation due to its strong association with riparian areas, which are often eliminated from harvesting to avoid adverse soil and water impacts. Therefore, the discussion of vegetation management level and this community type is limited to the

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EASTERN HEMLOCK AND WHITE PINE FORESTS

Table 3-13. Percent of Existing White Pine Forests in Each Vegetation Management Level by Alternative

	Vegetation Management Level			
	None	Low	Medium	High
Alternative A	14	13	51	22
Alternative B	17	20	25	38
Alternative D	9	9	20	62
Alternative E	27	16	53	4
Alternative F	17	11	27	45
Alternative G	29	44	25	2
Alternative I	17	9	64	10

white pine forest types. Table 3-13 shows the proportion white pine forests by vegetation management level by alternative. These figures show that Alternative D has the highest potential for increasing this community type through the use of vegetation management, with 82% of this community type in a moderate or high vegetation management level. Alternatives I, A, and F, in that order, have slightly decreasing percentages of the community type in a high or moderate vegetation management level, ranging from 74% to 72%. White pine can be expected to be increased under these alternatives as well, perhaps only slightly less than Alternative D. Alternatives B and E result in a much lower potential for vegetation management to increase this community type. The potential is moderate at 72%, 63%, and 57%, respectively, of the community type in a moderate to high vegetation management level. Finally, Alternative G has far and away the least potential for vegetation management to benefit white pine forest types with only 27% of the community type in a moderate or high vegetation management level.

In an attempt to combine the impact of prescribed fire in reducing the abundance of this community type and the impact of vegetation management enhancing this type, one can compare Table 3-12 and Table 3-13. Alternative D is likely to have no impact on abundance since it is both high in fire and vegetation management levels. Both activities work at cross-purposes insofar as this community type is concerned; abundance is likely to be maintained. Alternatives B and F are likely to result in reduced abundance of this community type since it has a higher ranking in the fire management level than the vegetation management level. Conversely, Alternatives I and A are likely to result in a slight increase in abundance, since these alternatives ranked higher in the vegetation management level than the fire management level. Alternatives E and G are likely to result in increased abundance as well, but only because they ranked so low in the fire management level.

Eastern hemlock forests are naturally limited in distribution, occurring primarily in association with north facing coves and slopes and riparian systems. Under all alternatives, forest-wide standards are included that defer existing hemlock forests from regeneration cutting during this plan period and that maintain the hemlock component where it occurs as patches within other forest types. These provisions are included under all alternatives in an effort to maintain mature hemlock forests in the face of threats to this type from the hemlock woolly adelgid. As a result of these provisions, little change to the distribution and abundance of eastern hemlock forest are anticipated as a direct or indirect effect of national forest management. However, long-term effects from the hemlock woolly adelgid may be large (refer to the Forest Health section of this Chapter).

CONDITION

Because hemlock forests would not be subject to regeneration cutting this planning period, hemlock forests would move into older age classes with Plan implementation, increasing potential abundance of mature forests of this type under all alternatives. Activities within hemlock stands would be limited under all alternatives and would promote mature forests with the desired multi-layered canopy condition that is needed by many species of wildlife. However, as mentioned previously, the hemlock woolly adelgid is expected to eventually result in deterioration and mortality of hemlock in this community type.

Because hemlock and white pine forests would be managed to optimize their natural distribution, abundance, and condition in all plan alternatives, potential effects through plan implementation to these vegetative communities should be positive. There are twenty-six species of plants and animals with viability concerns that are associated with hemlock forests (Appendix E). The positive direct and indirect effects of management, or in this case, the absence of management, to hemlock forest communities should contribute to the viability of these associated species under all alternatives. Because provisions for maintenance of hemlock are similar across all alternatives, the magnitude of these positive effects would be similar for all alternatives. Once again, however, the hemlock woolly adelgid, for which there is no operational control in general forest areas at this time, is likely to cause deterioration and mortality of hemlock forests despite the provisions of the Forest Plan to protect and enhance this component.

Cumulative Effects

A 39 percent increase in the acreage of white pine-hemlock forests has been documented across both public and private ownerships in the southern Appalachians since the mid 1970's (SAMAB 1996). This is largely attributable to an increase in managed stands of white pine (plantations) and upland encroachment of both white pine and hemlock into areas where it would not occur under a natural fire regime. The use of prescribed fire in the restoration of upland habitats will likely shrink these communities back to a more natural distribution on the landscape over time. Despite Plan protection and restoration objectives, the current amount and distribution of mature eastern hemlock forests is threatened by the recent emergence of the hemlock woolly adelgid in the southern Appalachians. The fact that this community type is naturally limited in distribution, coupled with the impending threats from the hemlock woolly adelgid that will impact species regardless of land ownership, leaves the long-term maintenance of historical distribution and abundance of this community type in question. The fate of associated viability concern species will be dependent upon their ability to adapt to changing environmental conditions associated with the deterioration and mortality of hemlock from within these communities. Species that utilize hemlock forests in addition to other vegetative community types will be more likely to persist than species that are obligates to the hemlock forest community.

MESIC DECIDUOUS FOREST

The mesic deciduous forests covered in this section include northern hardwood, mixed mesophytic, river floodplain hardwood, and eastern riverfront forest community types (USDA Forest Service, 1997). These forest types are characterized by relatively low levels of disturbance, and from a habitat perspective, their primary value is providing habitat for a variety of species dependant on mid- and late successional forest stages. It should be noted that the more mesic oak forest types are not addressed in this section, but are analyzed in the Oak and Oak Pine section.

For the purposes of this analysis, the following CISC Forest Types were included in defining mesic deciduous forests: Sugar maple-Beech-Yellow birch (CISC 81), Cove hardwood-White pine-Hemlock (CISC 41), Yellow poplar (CISC 50), Yellow polar-White oak-Red oak (CISC 56), Black walnut (CISC 82), Sweetgum-Yellow poplar (CISC 58), River birch-Sycamore (CISC 72), Cottonwood (CISC 73), Sugarberry-American elm-Green ash (CISC 63), Beech-Magnolia (CISC 69), Willow (CISC 74), and Sycamore-Pecan-American elm (CISC 75).

ABUNDANCE

The mesic deciduous forests addressed in this section are relatively uncommon in the Southern Appalachian Assessment area, comprising just over 10% of the land area (SAMAB 1996:23). Mesic deciduous forest communities such as northern hardwood, mixed mesophytic, and bottomland hardwood forests comprise 1.6%, 8.4%, and 1.2%, respectively, of the land area of the SAA area.

Table 3-14 displays the current acreage (and percent) of mesic deciduous forest by successional class, the percent of total mesic deciduous forest acreage in mid- and late successional stages, and the percent of total forest acres in mid- to late successional mesic deciduous forests for the Jefferson National Forest in 2002. While these forest communities occur throughout the entire Forest, higher concentrations are found on the richer soils found on the Glenwood and Clinch Ranger Districts and the Mount Rogers NRA. The Ridge and Valley Districts (primarily the New River Valley and New Castle Ranger Districts) contain relatively fewer, but still abundant, amounts of these community types evenly distributed throughout the area.

Table 3-14. Mesic Deciduous Forests by Current Successional Stage

Successional Stage	**Jefferson National Forest**	
	Acres	**Percent**
Early Successional	2,500	2%
Sapling/Pole	14,000	14%
Mid- Successional	49,200	49%
Late-Successional	35,500	35%
TOTAL	**101,200**	
Total acres of mid- and late-successional mesic deciduous forests	84,700	84%
% of total forested acres in mid- and late-successional mesic deciduous forests		12%

AGE CLASS DISTRIBUTION

For the Southern Appalachian Assessment area, the majority of the mesic deciduous forests are currently in older age classes. Across all ownerships, approximately 75-80% of maple-beech-birch (northern hardwoods), oak-hickory, and elm-ash-cottonwood (bottomland hardwoods) forests are in mid- and late successional stages (SAMAB 1996: 165). There are approximately 3.5 million acres of deciduous forest on National Forest system lands within the SAA area (SAMAB 1996:168). Of these acres, 2% are in early successional forest, 6% are in the sapling/pole forest, 45% are in the mid-successional forest and 46% are in late successional forest.

A key management issue for this community is maintenance of a high proportion of these community types in mid- and late successional conditions to provide habitat for associated species. There are a number of viability concern species that are broadly associated with mature mesic deciduous forests, and others that are more specifically associated with such forests at high elevations (Appendix E).

The current age class distribution of mesic deciduous forests for the Jefferson National Forests is shown in Table 3-14. Approximately 84% of these forest communities are in mid- and late successional stages. These older deciduous forest make up about 12% of the total forested acres on the Jefferson National Forest. Conversely, only about 2% of the mesic deciduous forest community types are in an early successional stage.

FOREST STRUCTURE

A number of bird species, including the cerulean warbler (*Dendroica cerulea*) favor mature, mesic hardwood forests with a diverse and well-developed canopy structure including canopy gaps and associated midstory and understory structural diversity (Ramey, 1996; Buehler and Nicholson, 1998; Rodewald and Smith, 1998; Nutt, 1998). Species of potential viability concern associated with canopy gaps and structurally diverse understories in mesic deciduous forests are identified in Appendix E. This structural diversity may be characteristic of the decadent, patchy conditions found in old growth forests, to which these species have presumably adapted. While a growing portion of the landscape in the Southern Appalachians consists of large hardwoods, most sites have very simple canopy structures (Runkle, 1985). This lack of structure is likely the result of previous even-aged timber management, resulting in forest stands of approximately equally-aged trees with low mortality and few canopy gaps. Most of these mid- and late successional forests have not yet begun to develop the canopy gaps characteristic of old growth forests. It may be many centuries before such structure develops through natural succession.

Intermediate treatments such as thinning can be used to improve forest structure in mesic deciduous forests. Canopy gaps created by these treatments would stimulate the development of the desired midstory and understory structure. Single-tree selection or small group selection (generally <0.75 acre group maximum size), implemented at relatively low intensities, achieve very similar desired conditions.

MANAGEMENT INDICATORS

Management indicators have been identified for assessing effects to mesic deciduous communities. These include both Management Indicator Species (MIS) and key habitat variables.

The hooded warbler (*Wilsonia citrina*) is a neotropical migrant that is fairly common to common throughout the southeastern United States during the breeding season (Hamel 1992). It is found in mixed hardwood forests of beech, maple, hickory and oaks with dense undergrowth (DeGraaf et al. 1991). It nests in saplings, shrubs or herbaceous vegetation. It also has been identified as a MIS for mesic deciduous forests with canopy gaps and structurally diverse understories. The hooded warbler is relatively common and evenly distributed throughout the Jefferson National Forest.

Key habitat variables identified for this community are total acres of mid- and late successional mesic deciduous forests and total acres treated to create canopy gaps.

Table 3-15. Proportion of current mesic deciduous forest in each successional stage option by alternative for the Jefferson National Forest

Alternative	Successional Stage Emphasis			
	None / Very Low	Low	Moderate	High / All
A	50	18	12	20
B	47	4	48	1
D	46	2	9	43
E	58	23	16	3
F	39	2	16	43
G	75	15	10	0
I	51	4	38	7

Direct and Indirect Effects

ABUNDANCE AND AGE CLASS DISTRIBUTION

The amount of regeneration treatments will affect the future quantity and distribution of mid- and late successional mesic deciduous forests. The future age class distribution of mesic deciduous forests would vary among alternatives due to the differences in management intensity and emphasis. Table 3-15 shows the proportion of existing mid- and late successional deciduous forest by successional stage option for the Jefferson National Forest. Those acres allocated to Management Prescriptions that have a "none" or "low" successional stage rating (Options 1 or 2) would emphasize mid- and late successional forests as compared to Management Prescriptions that have a "moderate" or "high" successional stage rating (Options 3 or 4), which would emphasize medium and high quantities of early successional forest.

For the Jefferson National Forest, the majority of the existing mesic deciduous forest would be allocated to prescriptions that would maintain the predominance of older forests (successional stage management opportunity of None, Very Low, or Low) in all alternatives except D and F. However, even under alternatives D and F, only moderate levels of early successional habitat would be created (10 percent or less) and mid- and late successional mesic forests would still be relatively common.

Table 3-16 shows the expected acres and percent of mid-late successional mesic deciduous forest on the Jefferson National Forest, after 10 and 50 years of implementing

Table 3-16. Expected acres and percent of mid-late successional mesic deciduous forest on the Jefferson National Forest, after 10 and 50 years of implementing Forest Plan alternatives

Alternative	10 Year		50 Year	
	Acres	Percent	Acres	Percent
A	88,200	87%	84,600	84%
B	90,400	89%	77,600	77%
D	85,300	84%	77,300	76%
E	89,600	89%	95,800	95%
F	80,300	79%	62,100	61%
G	91,200	90%	98,900	98%
I	89,500	88%	82,000	81%

forest plan alternatives based on SPECTRUM model outputs. Consistent with the discussion of management emphasis above, Alternatives D and F would result in the least number of acres (and percentage) of mid-late successional mesic deciduous forest communities. This would be true at the end of both the first and fifth decade of Forest Plan implementation. Conversely, Alternative G would result in the most acres and percentage in that same condition. However, the remaining alternatives (Alternatives A, B, E, and I) would all be very similar to Alternative G at the end of the first decade; ranging from 87% to 90% in a mid-late successional condition.

FOREST STRUCTURE

The forest types included here are not benefited by fire and many associated species are fire intolerant. Forest-wide objectives and standards have been established to minimize the acreage of these forests prescribed burned and reduce the impacts of prescribed fire in these communities when included as part of landscape-level burn units.

Table 3-17. Expected activity levels related to the creation of canopy gaps in mesic deciduous forests for the Jefferson National Forest by alternative

Activity	Acres of Group Selection and / or Thinning Only						
	Alt A	Alt B	Alt D	Alt E	Alt F	Alt G	Alt I
Acres of mid and late successional mesic hardwood forests to be treated to create canopy gaps during first decade of plan implementation	100	0	0	546	0	100	166
Percent of current total acres of this habitat type to be treated	0.1%	0.0%	0.0%	0.5%	0.0%	0.1%	0.2%

The ability to manage existing mid- and late successional mesic deciduous forests to create desired structural habitat conditions would vary among alternatives due to the differences in management intensity and emphasis, described above. Expected activity levels related to the creation of canopy gaps for all alternatives are shown in Table 3-17 for the Jefferson National Forests. Alternative E would result in the most acres of the mesic deciduous forest communities receiving a canopy gap treatment with approximately 546 acres of such treatments occurring in the first decade. Alternative I would rank second with about 166 acres of mesic deciduous forest receiving a canopy gap type of treatment. Alternatives A and G would treat only 100 acres, while the remaining alternatives would treat no acres in the mesic deciduous forest with canopy gap treatments.

Table 3-18. Expected population trend[1] of hooded warblers on the Jefferson National Forest under Forest Plan alternatives 10 and 50 years following plan adoption. Population trend estimates are based on expected trends in habitat quantity and quality.

Time Period	Alternative						
	A	B	D	E	F	G	I
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.

Canopy gap treatments that enhance structural diversity in mature mesic hardwoods would benefit species such as the hooded warbler as well as numerous other species associated with these habitat conditions. The hooded warbler responds to the understory growth that ultimately results from canopy gaps. Its highest population densities are expected in these situations. Average breeding densities reported by Hamel (1990:C-8) are 16.0 pairs per 100 acres. Populations are expected to be highest under alternatives that provide for more creation of canopy gaps and older decadent forests. Alternatives E and I would benefit this species the most. Alternatives A and G would benefit this species moderately. The following table displays how the hooded warbler is expected to respond to each of the plan alternatives.

Although not a MIS, the cerulean warbler also responds to changes in canopy structure resulting from canopy gaps. In the short-term, alternatives that provide for more creation of structural diversity in close-canopied mesic deciduous forests are expected to support larger populations of this species than alternatives that provide less of this condition; however, breeding densities are expected to remain low under all alternatives due to the position of the forest within its range (Hamel 1992:275). In the long-term, alternatives that provide the highest levels of late successional mesic deciduous forests are most likely to support the largest populations of this species.

Cumulative Effects

The potential for cumulative actions, that is actions on privately held lands or lands administered by other agencies, to affect the vegetation on National Forest System lands and vice-versa is minimal to non-existent. Vegetation does not move, so there is no potential for actions on non-NFS lands to directly impact the vegetation on NFS lands, or actions on NFS lands to directly impact non-NFS lands.

Indirectly, there may be an edge effect if management actions were to occur directly adjacent to a NFS boundary. This effect of increasing solar radiation resulting in increased growth of the understory in the adjacent land can be expected to reach no more than two tree heights, or 150 to 200 feet, into the surrounding mature forest from an opening. The extremely small area that could experience such an impact is too negligible to warrant concern at this level of analysis.

The only other potential for indirect cumulative impacts is that occurring from seed dispersal. Several tree species associated with these community types (maples and yellow poplar) are wind-dispersed. Thus, actions that increase these species could increase the potential seed source that would be blown to neighboring tracts of land, thereby increasing the potential for more such species in the general area. It should be noted, however, that this impact merely reflects a potential change in species composition within the mesic deciduous forests. The larger controlling factor for the overall distribution and abundance of such community types is related to site factors; that is a mesic site with rich productive soils generally found on the more northerly or easterly aspects. Such sites are currently occupied by a mesic deciduous forest and the amount of wind-dispersed seed would only have a very minor effect on the composition within those sites, not the overall amount and distribution of the mesic deciduous forest. Furthermore, the species of interest here (maples and yellow poplar) are currently so prolific on both NFS and Non-NFS lands that any increase in seed potential would not result in a measurable effect. There is already more than enough seed present for such species.

OAK AND OAK-PINE FORESTS

Oak dominated forests covered under this section include: dry-mesic oak forests; dry and xeric oak forests, woodlands, and savannas; and dry and dry-mesic oak-pine forests. The dry-mesic oak forests and dry and xeric oak forests, woodlands, and savannas vary greatly in their species composition due to their wide distribution. The major species include chestnut oak (*Quercus montana*), northern red oak (*Q. rubra*), black oak (*Q. velutina*), white oak (*Q. alba*), and scarlet oak (*Q. coccinea*) (USDA Forest Service, 1997). The dry and dry-mesic oak-pine forests considered here are oak-dominated forests containing a significant pine component. Predominant pine species include white pine (*Pinus strobus*), shortleaf pine (*P. echinata*), Virginia pine (*P. virginiana*), and loblolly pine (*P. taeda*).

For purposes of this analysis, the following CISC Forest Types are included in this section: Post oak-Black oak (CISC 51), White oak-Red oak-Hickory (CISC 53), White oak (CISC 54), Northern red oak-Hickory (CISC 55), Chestnut oak (CISC 52), Scrub oaks (CISC 57), Scarlet oak (CISC 59), Chestnut oak-Scarlet oak (CISC 60), Upland hardwoods-Yellow pine (CISC 42), Oaks-Eastern red cedar (CISC 43), Southern red oak-Yellow pine (CISC 44), Chestnut oak-Scarlet oak-Yellow pine (CISC 45), Bottomland hardwoods-Yellow pine (CISC 46), White oak-Black oak-Yellow pine (CISC 47), and Northern red oak-Hickory-Yellow pine (CISC 48).

ABUNDANCE

In the Southern United States, acres of oak-hickory and oak-pine forests have increased over the last 50 years. (USDA Forest Service 2001). Oak and oak-pine forests are common throughout the South, comprising over half of the timberland of the region as a whole. Oak-hickory forests are the dominant forest type in the Southern Appalachian Ecoregion, and are codominant with loblolly-shortleaf pine forests in the Piedmont Ecoregion. Southern yellow pine forest types dominate the Coastal Plain Ecoregion, but oak and oak-pine forests still comprise nearly 30 percent of the timberland in this Ecoregion.

Table 3-19 displays the current acreage (and percent) of oak and oak-pine forest[1] by successional class, the percent of total oak forest acreage in mid- and late successional stages, and the percent of total forest acres in mid- to late successional oak forests on the Jefferson National Forest. The Jefferson National Forest contains approximately 536,100 acres of oak and oak-pine forests, comprising about 76% of the Forest. The oak types are by far the most dominant of the three communities, occupying some 389,500 acres that are well distributed across the entire Forest with plentiful representation on all Districts. By contrast, oak-pine types only comprise about 146,600 acres and very little of this community is found on the Clinch Ranger District or the higher elevations of the Mount Rogers NRA. However, these mixed types are fairly common and well distributed on the remaining Districts.

Table 3-19. Oak and Oak-Pine Forests by Current Successional Stage

Successional Stage	Jefferson National Forest Acres	Percent
Early Successional	4,600	1%
Sapling/Pole	34,300	6%
Mid- Successional	209,600	39%
Late-Successional	235,700	44%
100+	52,000	10%
TOTAL	**536,200**	
Percent of JNF Acres		**76%**

The abundance of these forests in the future will be primarily dependant on the management of existing oak stands to maintain oak dominance. However there also are opportunities to increase the availability of these forests, especially the mixed oak-pine types, through various regeneration techniques and supplemental planting of pine species.

AGE CLASS DISTRIBUTION

Across the Southern United States, about 50% of the upland hardwood forests (predominantly oak-hickory) and 30% of the natural oak-pine forests are in mid- and late successional stages (41+ years of age) (USDA Forest Service 2001). However, only about 1% of the planted oak-pine forests are in mid- and late successional stages. For the Southern Appalachian Assessment Area, approximately 75% of oak-hickory forests are in mid- and late successional stages (SAMAB 1996: 165).

The current age class distribution of oak and oak-pine forests for the Jefferson National Forest is shown in Table 3-19 in the form of 5 successional classes. This age class distribution on the Jefferson National Forest follows a pattern common to many other Southern Appalachian Forests. However, on the Jefferson, this pattern is a little more extreme with approximately 93% of these community types in a mid-late successional stage (age greater than 40 years old), while only 7% of this type is in an early-sapling stage (40 years old or less).

FOREST STRUCTURE

The structural condition of these oak and oak-pine forests is a key factor in the maintenance of these communities. Research indicates that oak and oak-pine forests may not perpetuate themselves without some level of disturbance, especially on mesic sites (Loftis 1991). Treatments such as shelterwood harvest combined with prescribed burning (Brose et al. 1999) or basal area reduction from below using herbicides (Loftis 1991) have been shown to create conditions that promote adequate oak regeneration. Once established and grown to an average height of approximately 4.5 feet, oak advanced regeneration should be released and provided relatively full sunlight to encourage quick growth into the canopy of the regenerated stand. Oak dominance can be maintained with suitable tree densities and moderate fire return intervals.

Treatments such as moderate thinning and prescribed burning also can be used to create the desired habitat conditions of moderate light levels in otherwise closed canopy oak and oak-pine forests. There are a number of viability concern species that are associated with open canopy condition and moderate levels of prescribed burning in the oak and oak-pine forests (Appendix E).

MAST PRODUCTION

Mid- and late successional oak and oak-pine forests provide an important source of hard mast and dens. Acorns are a critical fall and winter food for numerous wildlife species (Martin et al. 1951). The availability of acorns has been shown to strongly influence population dynamics of species such as black bear (Pelton, 1989), squirrels (Nixon et al. 1975), white-tailed deer (Wentworth et al. 1992) and white-footed mice (Wolff 1996). The large diameter hollow trees and snags found in older oak forests also are an important source of dens for black bears (Carlock et al. 1983). Hard mast production is an important habitat feature for a several wildlife species in demand for sport hunting. These include white-tailed deer, wild turkey, squirrels, and bear. However, there are no mast dependant viability concern species identified for the Southern Appalachian Ecoregion.

MANAGEMENT INDICATORS

Several management indicators have been identified for assessing effects to oak and oak-pine forest communities. These indicators include both Management Indicator Species (MIS) and key habitat variables.

The hooded warbler (*Wilsonia citrina*) is a neotropical migrant that is fairly common to common throughout the southeastern United States during the breeding season (Hamel 1992). It is found in mixed hardwood forests of beech, maple, hickory and oaks with dense undergrowth (DeGraaf et al. 1991). It nests in saplings, shrubs or herbaceous vegetation. It has been identified as a MIS for managed oak forest containing a well developed understory. Also, the scarlet tanager (*Piranga olivacea*) has been identified as an MIS for drier oak forests that have more of an open condition.

Five key variables for tracking management effects on these community types are selected. To indicate the level of management activity directed at establishing advanced regeneration in these community types; acres of the types burned annually and acres thinned annually are projected. To indicate the level of management activity directed at releasing already established regeneration, acres of the types receiving treatments that provide a substantial increase in light levels (e.g. even-aged and two-aged treatments) are projected. Cumulatively, restoration efforts are tracked by the annual acreage of oak and oak-pine forest restored to appropriate sites currently occupied by other forest types. It should be noted, however, that there is little or no need for restoration of this community type on the Jefferson National Forest as this type is quite plentiful, well distributed, and generally occupies appropriate sites. Restoration of this type is more meaningful in those areas where pine plantations, usually yellow pine plantations, occupy sites that were historically oak or oak-pine sites. While this was a common practice on other forests further south in the SAA, little yellow pine conversion has taken place in the mountains of Virginia. Because older oak forests are an important source of oak mast and dens, total acres of mid- and late successional oak and oak-pine forests are also projected.

Direct and Indirect Effects

ABUNDANCE

The future abundance of oak and oak-pine forests is primarily related to the maintenance of stand conditions that ensure oak dominance and replacement. Expected activity levels related to the maintenance and restoration of oak and oak-pine forests for all alternatives are shown in Table 3-20. By combining the ranking of each alternative for both prescribed fire and thinning treatments, we can compare the overall effect of the alternatives relative to each other on these community types. Alternative B has the highest ranking in combined prescribed fire and thinning in these community types; it would be expected to benefit these community types the most. Conversely, Alternative F has the lowest rankings in these two activities; it would benefit these community types the least. Alternatives G, I, A, E, and D would fall in between these alternatives, having a moderate benefit to these community types.

The ability to meet these activity levels, to manage these forests to ensure adequate oak regeneration, and to provide habitat conditions for species associated with open canopy condition and moderate levels of prescribed burning will vary among alternatives due to the differences in management intensity and emphasis. To compare the potential level of maintenance and restoration activities among alternatives, the current distribution of oak and oak-pine forests was compared with the prescription allocations by alternative. Prescriptions were rated as to the management opportunity (none, low, medium, and high) they provide for the levels of thinning and burning desirable for oak management. The

BIOLOGICAL ENVIRONMENT

MAJOR FOREST COMMUNITIES

OAK AND OAK-PINE FORESTS

Table 3-20. Expected Annual Activity Levels Related to the Maintenance and Restoration of Oak and Oak-Pine Forests by Alternative

Activity	Alternative A	B	D	E	F	G	I
Average annual acres (approximate) of oak and oak-pine forests to be burned	7,800	10,900	8,200	5,500	0	9,000	8,500
Average annual acres (approximate) of oak and oak-pine forests to be thinned*	800	300	300	500	80	60	400
Average annual acres (approximate) of oak and oak-pine forest receiving even-aged/two-aged treatments	1,300	800	2,700	100	800	200	900
Average annual acres of oak and oak-pine forests to be restored	0	0	0	0	0	0	0
TOTAL	9,900	12,000	11,200	6,100	880	9,260	9,800

*Derived from SPECTRUM, average of any thinning only treatment over 50 year projection.

proportion of the existing oak and oak-pine forests in each management opportunity level is shown in Table 3-21.

The variation in the acres of these community types in a moderate or high potential for management is relatively low. Values range from 64% to 83%. Thus, all alternatives maintain some level of vegetation manipulation and provide for the maintenance of the community types. The following discussion is intended to contrast the minor differences between the alternatives.

Alternative D would have the greatest potential for maintaining and/or increasing the amount of oak and oak-pine forests since fully 83% of the existing acreage would have a moderate to high potential for vegetation manipulation; that is to create more open canopies and/or use prescribed fire to enhance oak presence in the understory. This results primarily from the relatively larger allocation of Management Prescription 10's under this alternative. It should be noted, however, that much of this vegetation

Table 3-21. Proportion of Oak and Oak-Pine Forest in Management Opportunity Level by Alternative

Alternative	Management Opportunity Level[1] None	Low	Moderate	High
A	0	25	45	30
B	1	23	37	39
D	1	16	22	61
E	0	36	59	5
F	0	29	19	52
G	1	35	43	21
I	0	33	30	37

[1] Management Opportunity Level: An average of the Vegetation Management and Fire Options (rounded to next whole number).

management would be regeneration of this community type since balancing age classes is the focus of Alternative D. Thus, while Alternative D does have the greatest potential for manipulating this community type, it would likely result in less mid- and late- seral stages as the stands are regenerated.

At the other end of the spectrum Alternatives E and G have the least potential for managing the oak and oak-pine forests; 36% of this community type would have low or no potential for vegetation manipulation. This results from the focus of Alternative E on recreation related values and less vegetative manipulation and the focus of Alternative G on maintaining large undisturbed areas. Alternatives I has the second least potential for manipulating these community types. Alternative I would allow for a variety of different treatments to maintain and regenerate oak and oak-pine communities. (thinning and prescribed fire) as the focus of that Alternative is to enhance habitats for a variety of wildlife species.

Alternatives A, B, and F would have a more moderate positive impact on the oak and oak-pine forests. These alternatives have a moderate to high potential for manipulation on 71% to 75% of these community types. Alternative B has the second highest potential for manipulating these community types. Since Alternative B does focus on restoring community types and creating and maintaining wildlife habitats, it would allow more intermediate stand treatments (thinnings and prescribed burning) to enhance the oak and oak-pine forests as compared to Alternative D above. Thus, Alternative B is likely to be most beneficial to the oak and oak-pine forests. Impacts under Alternative F would be somewhat similar to those discussed for Alternative D above since balancing of age-classes is a primary goal under current management. However, this impact would occur on less acres as compared to Alternative D. Similar to Alternative I discussed above, Alternative A would allow for a mix of both intermediate and regeneration treatments while providing goods to local economies. Therefore, less reduction of mid- and late-seral stages of oak and oak-pine forests may occur under Alternative A as compared to Alternative F.

AGE CLASS DISTRIBUTION

The future age class distribution of oak forests will vary among alternatives due to the differences in management intensity and emphasis. Table 3-22 and Table 3-23 show the expected acreage and percent of oak and oak-pine forests by seral stage on the Jefferson National Forest, after 10 and 50 years of implementation. Alternatives D, B, and A result in the most early seral habitat in these community types after 10 years, and the same is true for Alternatives D and B only after 50 years. Alternatives E and G result in the most mid and late seral habitat after 10 years and 50 years.

Table 3-22. Expected acreage (thousands of acres) of oak and oak-pine forests by successional stage, after 10 and 50 years of implementing forest plan alternatives

Alternative	Early		Pole		Mid		Late		100+	
	10yr.	50yr.	10yr.	50yr.	10yr.	50yr.	10yr.	50yr.	10yr.	50yr.
A	17	7	29	40	90	46	333	130	66	313
B	15	10	29	23	90	44	333	133	69	325
D	24	20	29	92	90	53	328	109	65	261
E	2	1	29	3	90	31	339	140	75	360
F	9	11	29	27	90	39	338	141	69	319
G	3	3	29	4	90	32	340	141	74	356
I	13	12	29	29	90	42	333	135	71	318

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OAK AND OAK-PINE FORESTS

Table 3-23. Expected percentage of oak and oak-pine forests by successional stage after 10 and 50 years of implementing forest plan alternatives

Alternative	Early		Pole		Mid		Late		100+	
	10yr. %	50yr. %	10yr. %	50yr. %	10yr. %	50yr. %	10yr. %	50yr. %	10yr. %	50yr. %
A	3	1	5	8	17	9	62	24	12	58
B	3	2	5	4	17	8	62	25	13	61
D	4	4	5	17	17	10	61	20	12	49
E	0	0	5	1	17	6	63	26	14	67
F	2	2	5	5	17	7	63	26	13	60
G	1	0	5	1	17	6	63	26	14	66
I	2	2	5	5	17	8	62	25	13	59

FOREST STRUCTURE

As discussed above, the ability to manage these oak and oak-pine forests to ensure adequate oak regeneration and to provide habitat conditions for species associated with open canopy structure will vary among alternatives due to the differences in management intensity and emphasis (Table 3-21). However, the acres of moderate to high potential for vegetation manipulation do not vary severely from one alternative to another; they range from 64% to 83% of the total acreage of the oak and oak-pine forests. Thus, under no Alternative are these community types expected to be seriously reduced and no corresponding indicator species populations would be expected to be adversely impacted. Therefore, the following discussion attempts to contrast the minor differences between the alternatives.

Tables 3-24 and 3-25 show the expected population trends for the hooded warbler and scarlet tanager for each alternative. While Alternative D provides the greatest potential for vegetation management in the oak and oak-pine forests, much of this vegetation manipulation would likely result in even-aged regeneration of these community types and less creation of small canopy gaps and thinnings to promote well developed understories. Such habitat would be less suited to the hooded warbler (*Wilsonia citrina*) as compared to the other alternatives. Populations of this MIS would be expected to remain stable under this alternative.

Conversely, Alternatives E, G, and I have lower potentials for vegetation manipulation. Given the focus of Alternatives E and G (recreation and large undisturbed tracts, respectively), relatively fewer acres of canopy gaps and thinnings resulting in well developed sapling and/or shrub layers would be created. Canopies would remain closed and little change in understory composition or structure would be expected. These alternatives would also benefit the hooded warbler less than other alternatives, however, populations of the hooded warbler would be expected to remain steady under these alternatives. Populations of scarlet tanagers would benefit from the large acreage of undisturbed canopy. Alternative I would focus on the creation of adequate habitat for various wildlife species, including the use of canopy gap treatments and thinnings to promote habitat for the hooded warbler. Thus, while relatively few acres would be available for vegetation manipulation under this alternative, the treatments themselves would likely favor this species. Populations of the hooded warbler and scarlet tanager would be expected to increase slightly under Alternative I.

Alternatives A, B, and F would allow for a moderate level of vegetation manipulation in these community types. Alternatives A and B would provide the most beneficial impact to the hooded warbler since those alternatives result in more intermediate stand treatments and/or focus on maintaining and restoring wildlife habitats. These alternatives would be expected to result in an increase in populations of the hooded warbler. Effects under alternative F would be similar to those described for Alternative D above, but would occur on less acres. The intensity and variety of vegetation manipulation would create open canopies and allow the development of denser understories. Populations of hooded warblers under these alternatives would likely remain stable under Alternative F. The following tables display the expected response of hooded warbler and scarlet tanager populations to each of the alternatives.

MAST PRODUCTION

Acorn production is greatest in mid- and late successional oak and oak-pine forests. As discussed above, the expected quantity of mid- and late successional oak and oak-pine forests will vary among alternatives (Table 3-22) as will the availability of oak mast. As previously mentioned, the variability in management opportunity levels between the Alternatives is not great. No Alternative is expected to result in a reduced abundance of these community types or hard mast producing communities.

Alternatives D and B, in that order, provide the greatest potential for vegetation management in the oak and oak-pine forests. However, relatively more acres would be regenerated to new age classes under Alternative D. Relatively less acre of the hard-mast producing mid- and late- seral stages would be maintained. Black bear populations would not be enhanced in the short-term due to this reduction in hard mast relative to other Alternatives. However, since very old oak trees experience a loss of vigor, resulting in reduced hard mast production as they become older aged, both of these alternatives will ultimately provide for sustained oak mast production into the long term. Stands

Table 3-24. Expected population trend[1] of hooded warblers on the Jefferson National Forest under forest plan revision alternatives 10 and 50 years following plan adoption. Population trend estimates are based on expected trends in habitat quantity and quality.

	Alternative						
Time Period	**A**	**B**	**D**	**E**	**F**	**G**	**I**
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.

Table 3-25. Expected population trend[1] of scarlet tanagers on the Jefferson National Forest under forest plan revision alternatives 10 and 50 years following plan adoption. Population trend estimates are based on expected trends in habitat quantity and quality.

	Alternative						
Time Period	**A**	**B**	**D**	**E**	**F**	**G**	**I**
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.

regenerated now will come into their most vigorous mast production 60 to 80 years from now. Thus, overall, black bear populations would remain stable under these alternatives insofar as hard-mast production influences those populations (all other factors remaining constant).

Alternatives E, I, and G have lower potentials for vegetation manipulation. In the shorter-term, black bear would continue to increase as den sites become more plentiful (aging forests) and hard-mast production continues. But as time passes, more and more forests would become older aged and hard mast would ultimately be reduced due to declining stand vigor. This would be especially true of Alternatives E and G given the focus of those alternatives. Bear populations may benefit the least in terms of sustained hard mast production (all other factors remaining constant) as compared to the other Alternatives.

Alternatives A and F would allow for a moderate level of vegetation manipulation in these community types. Black bear populations would certainly be maintained and perhaps enhanced. Since these alternatives would provide more of a balance of mid- and late-seral stages versus regenerated stands to continue vigorous mast production in the long-term, supplies of hard mast would be adequate in both the short- and long-terms.

Cumulative Effects

The potential for cumulative actions, that is actions on privately held lands or lands administered by other agencies, to affect the vegetation on National Forest System lands is minimal to non-existent. Vegetation does not move, so there is no potential for actions on non-NFS lands to directly impact the vegetation on NFS lands, or vice versa.

Indirectly, there may be an edge effect if management actions were to occur directly adjacent to a NFS boundary. This effect of increasing solar radiation resulting in increased growth of the understory in the adjacent land can be expected to reach no more than 2 tree heights, or 150 to 200 feet, into the surrounding mature forest from an opening. The extremely small area that could experience such an impact is too negligible to warrant concern at this level of analysis.

The only other potential for cumulative impacts is that occurring from seed dispersal. Given the size and weight of acorns, such combination of impact is unlikely to occur. Oak acorns rarely move far from the parent tree, even with the help of squirrel caching. Pine seed, however, is wind-dispersed. Thus, actions that increase the pine component could increase the potential seed source that would be blown to neighboring tracts of land, thereby increasing the potential for more pine in the general area. Alternative D could ultimately have this affect on neighboring lands in the long run as the oak and oak-pine components may increase under this alternative. All other alternatives would either maintain, or perhaps slightly decrease, the amount of oak-pine component due to lower levels of management.

Conversely, actions on neighboring lands could have a similar impact on NFS lands. However, lands administered by the National Park Service (Blue Ridge Parkway), the Army Corps of Engineers (John W. Flannagan Reservoir), and the Virginia Department of Conservation and Recreation (Hungry Mother, Breaks Interstate, and Grayson Highlands State Parks) are unlikely to be altered through vegetation management actions. No such cumulative impact can be identified. The Clinch Mountain State Wildlife Management Area does receive a degree of vegetation manipulation. Presumably, this area would be similar to the Jefferson National Forest Alternatives B, A, and F I with respect to the ability to increase the pine component. Trends of the oak-pine community over the entire Southern Appalachian Assessment area show a slight increase and much of this increase is attributed to private industrial forests (SAMAB 1996, pg. 27). Assuming this trend continues, activities on privately held lands would increase the amount of pine seed that could be blown onto NFS lands, thereby contributing to an increase in the oak-pine community on NFS lands.

PINE AND PINE-OAK FORESTS

Pine-dominated forests covered in this section include the xeric pine and pine-oak forest and woodland community type. These forests are often referred to as southern yellow pine forests and occur on a variety of landforms at a wide range of elevations. Historically, in the Blue Ridge Physiographic Province, these communities occupied areas that were subject to natural fire regimes and typically occurred on ridges and slopes with southern exposures (NatureServe 2002). However, due to a combination of previous land use, fire exclusion, and intensive forestry (plantations), many pine species that do not tolerate fire well have expanded beyond their normal sites and today, pine-dominated communities can be found on a variety of landforms and aspects. Meanwhile, pine species that benefit from or depend upon fire, such as Table Mountain pine, have been reduced in abundance.

For purposes of this analysis, the following CISC Forest Types are included in this section: Eastern redcedar-Hardwoods (CISC 11), Shortleaf pine-oaks (CISC 12), Pitch pine-oaks (CISC 15), Virginia pine-oaks (CISC 16), Table Mountain pine-Hardwoods (CISC 20), Longleaf pine (CISC 21), Virginia pine (CISC 33), Pitch pine (CISC 38), Table Mountain pine (CISC 39), Eastern red cedar (CISC 35), and Black locust (CISC 88).

ABUNDANCE

During the last 50 years across the southeastern United States, pine plantations have increased in importance in terms of a supply of wood products, expanding from 1% of the total pine forest acres to 48% of those acres (USDA Forest Service 2001: 1). It should be noted, however, that this expansion has occurred primarily in the piedmont and coastal plains of the south; relatively few pine plantations have been established on the Jefferson National Forest or in the mountains of Virginia. At the same time, the 20-year trend reported for the Southern Appalachian Assessment area (SAMAB 1996: 27) shows a downward trend of 16% for southern yellow pine forests. This trend is not, however, reflected in monitoring of this community type on the George Washington and Jefferson National Forests (GWJNF). The number of acres in this community type inventoried through the Continuous Inventory of Stand Conditions (CISC) on the George Washington National Forest has decreased less then 1% over the past decade (George Washington and Jefferson National Forest 2001). However, Forest Inventory and Analysis data indicate a substantial decrease in the acres of Virginia, pitch, and table mountain pines on the GWJNF since 1977 (George Washington and Jefferson National Forest 2001). So, while the decrease in the yellow pine community may not have been significant over the past decade, it has been dramatic over the past 30 years, indicating that much of the loss occurred prior to the past decade. A shift from more fire tolerant yellow pines to less fire tolerant pines may also be masked in this data. The Jefferson National Forest currently contains approximately 41,000 acres in the xeric pine and pine-oak forest and woodland community type, representing about 6% of the Jefferson National Forest.

The Jefferson National Forest experienced a southern pine beetle epidemic in the mid 1990's. While the exact acreages of southern yellow pine forests that were severely impacted are not known, this insect pest certainly resulted in a recent significant impact in terms of the condition or quality of existing yellow pine stands. Many of the sites impacted were densely stocked stands of Virginia, Table Mountain, and/or pitch pine that had proliferated beyond their normal sites due to fire suppression and land management practices of the past 70 years. Historical data suggests that large areas that have become occupied by even-aged stands of yellow pine would have naturally supported mixed stands with varying levels of hardwoods. Some areas experiencing frequent fire would have contained open understories with grassy and/or herbaceous ground cover. These natural communities are maintained by low intensity fires originating on ridgetops and southern exposures (NatureServe 2002). Other areas with less frequent fire would contain a mix of pine and hardwood species. With large-scale mortality in these communities due to pine beetle effects, the opportunity now exists to restore the condition and/or quality of these sites to a more open pine woodlands or natural mixed pine hardwood community.

AGE CLASS DISTRIBUTION AND FOREST STRUCTURE

On the Jefferson National Forest, the xeric pine and pine-oak community is well distributed throughout the ridge and valley province. However, this type is currently less abundant on the richer Blue Ridge Province soils of the Glenwood District, the Mount Rogers National Recreation Area and the Cumberland Plateau Province on the Clinch District.

The Southern Appalachian Assessment (SAMAB 1996) summarizes the age class distribution of southern yellow pine forests across the Southern Appalachian Assessment Area by a variety of land ownerships. Similar information is derived from queries of the Jefferson National Forest CISC Database. Table 3-26 provides a summary of this information. This data indicates that this community type is very strongly skewed to the older age classes as compared to the Southern Appalachian Assessment area as a whole.

Table 3-26. Current successional stage distributions (in %) for southern yellow pine forests across several ownerships in the Southern Appalachian Assessment Area

Successional Stage	Jefferson NF	All Public Lands	All Private Lands	All Ownerships
Early Successional	<1%	10%	18%	16%
Sapling/Pole	<1%	9%	19%	18%
Mid- Successional	7%	32%	59%	55%
Late-Successional (includes old growth)	92%	49%	4%	11%

National Forest data is derived from the CISC Database. Data for other ownerships is derived from FIA and LANDSAT data

Several species of viability concern are associated with late successional southern yellow pine forests maintained in open conditions by frequent fire (Appendix E). While public lands support the majority of late successional acres, the structure and composition of these forests has been altered due to years of fire suppression resulting in less than optimal habitat conditions. Fire intolerant species such as Virginia pine have proliferated while other pines (shortleaf, pitch, table mountain) have seen dramatic reductions (Nature Serve 2002, Martin et al. 1993). In the absence of fire, hardwoods, shrubs, and vines have replaced the open, grassy, herbaceous layer that is characteristic of frequently burned areas, and hardwoods have encroached into the midstory further affecting forest structure. This change in forest structure and resulting habitat condition has had a direct effect on species dependant upon these communities. Populations of several bird and reptile species associated with southern pine forests are in decline (Dickson 2001) as various habitat components are lost. In addition to declines in species dependant upon specific habitat attributes, entire pine communities are experiencing a reduction in abundance. Recent studies show that acreage of table mountain pine communities (considered a rare community in the southern Appalachians) has decreased due to fire suppression (Turrill and Buckner 1995) and that many remaining examples have substantial hardwood invasion. However, recent monitoring of the Table Mountain pine types on the GWJNF indicates the decline of Table Mountain pine has stabilized since 1977 (George Washington and Jefferson National Forest 2001).

MANAGEMENT INDICATORS

The pine warbler (*Dendroica pinus*) is selected as a management indicator species (MIS) to represent pine and pine-oak forests. The pine warbler is closely associated with pine and pine-oak forests, generally occurring only where some pine component is present. In addition, because fire plays such a prominent role in the maintenance and restoration of this community type, the other management indicator identified for assessing effects to pine and pine-oak forest communities will be the number of acres of xeric pine and pine-oak forests and woodlands burned. This activity indicates the level of effort directed at maintaining or restoring the xeric pine and pine-oak communities.

Direct and Indirect Effects

ABUNDANCE

The future distribution of pine and pine-oak forests on the Jefferson National Forest will vary among alternatives in relation to management objectives for the maintenance and restoration of these community types, primarily the use of prescribed fire. Table 3-27 lists the expected activity levels related to maintenance and restoration of the xeric pine and pine-oak forests by alternative.

The ability to meet these activity levels under each alternative varies based upon differences in the emphasis and subsequent management intensity of each alternative. To compare the potential level of maintenance and restoration activities among alternatives, the current distribution of southern yellow pine forests was compared with the management prescription allocations for each alternative. Prescriptions were rated as to the management opportunity they provide for varying levels of vegetation management and prescribed burning (none, low, medium, and high). The proportion of existing southern yellow pine forests in each management opportunity level is shown in Table 3-28.

Alternatives B and D would result in the highest number of acres of the xeric pine and pine-oak community being burned. These alternatives also rank first and third in terms of the management opportunity level as 96% and 93% of this community type, respectively, would be allocated to management prescriptions that allow for moderate to high levels of management. The xeric pine and pine-oak community type would be expected to benefit the most under these alternatives.

Alternatives A, G, and I would result in a relatively moderate number of acres of the xeric pine and pine-oak community being burned. Alternatives A and I were also relatively moderate in ranking in terms of the management opportunity level; 88% and 91% of this community type, respectively, would be allocated to management prescriptions that allow

Table 3-27. Expected activity levels related to the maintenance and restoration of southern yellow pine forests on the Jefferson National Forest

	Alternative						
Activity	**A**	**B**	**D**	**E**	**F**	**G**	**I**
Average annual acres of the xeric pine and pine-oak community type burned	1,651	2,561	2,156	1,214	0	1,814	1,754

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Table 3-28. Proportion of existing southern yellow pine forests on the Jefferson National Forest in each management opportunity level by alternative

Alternative	Management Opportunity Level [1]			
	None	Low	Moderate	High
A	3	9	51	37
B	1	3	19	77
D	1	6	19	74
E	1	20	57	22
F	2	3	31	64
G	1	37	17	45
I	1	8	52	39

[1] Management Opportunity Level: An average of the Vegetation Management and Fire Options (rounded to next whole number).

for moderate to high levels of management. The xeric pine and pine-oak community type would be expected to benefit under these alternatives, but perhaps not as well as under Alternatives B and D.

Alternatives E and F would result in the least number of acres of the xeric pine and pine-oak community being burned. Alternatives E was also relatively low in ranking in terms of the management opportunity level; 79% of this community type would be allocated to management prescriptions that allow for moderate to high levels of management. The xeric pine and pine-oak community type would be expected to remain stable under these alternatives, but would benefit the least as compared to all other alternatives. Table 3-29 summarizes the expected effects of each alternative upon pine warbler populations.

AGE CLASS DISTRIBUTION AND FOREST STRUCTURE

Future age class distributions and forest structure will vary among alternatives due to the differences in management intensity and emphasis as shown above in Table 3-28. The ability to use fire as a management tool will play a critical part in restoring natural species assemblages and forest structure within the southern yellow pine communities.

As shown in Table 3-28, opportunities exist to manipulate vegetation in southern yellow pine forests through prescribed fire and other vegetation management techniques under all alternatives. Projected activities should be sufficient to enhance existing habitat conditions within xeric pine and pine-oak forests above their current levels. Longer rotation ages coupled with more frequent fire will enhance habitat attributes such as grassy understories and standing snags needed by several declining bird species (Dickson

Table 3-29. Expected population trend[1] of pine warblers on the Jefferson National Forest under forest plan revision alternatives 10 and 50 years following plan adoption. Population trend estimates are based on expected trends in habitat quantity and quality.

Time Period	Alternative						
	A	B	D	E	F	G	I
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.

2001). Analysis indicates that, under all alternatives, in 50 years this habitat element will be relatively abundant and well distributed across the forest.

Cumulative Effects

The potential for cumulative actions, that is actions on privately held lands or lands administered by other agencies, to affect the vegetation on National Forest System lands is minimal to non-existent. Vegetation does not move, so there is no potential for actions on non-NFS lands to directly impact the vegetation on NFS lands, or vice versa.

Indirectly, there may be an edge effect if management actions were to occur directly adjacent to a NFS boundary. This effect of increasing solar radiation resulting in increased growth of the understory in the adjacent land can be expected to reach no more than 2 tree heights, or 150 to 200 feet, into the surrounding mature forest from an opening. The extremely small area that could experience such an impact is too negligible to warrant concern at this level of analysis.

The only other potential for cumulative impacts is that occurring from seed dispersal. Pine seed, is wind dispersed. Thus, actions that increase the pine component could increase the potential seed source that would be blown to neighboring tracts of land, thereby increasing the potential for more pine in the general area. Alternatives B and D could ultimately have this affect on neighboring lands in the long run as the pine and pine-oak components may increase under these alternative. All other alternatives would either slightly increase or maintain the amount of pine and pine-oak communities due to lower levels of management.

Conversely, actions on neighboring lands could have a similar impact on NFS lands. However, lands administered by the National Park Service (Blue Ridge Parkway), the Army Corps of Engineers (John W. Flannagan Reservoir), and the Virginia Department of Conservation and Recreation (Hungry Mother, Breaks Interstate, and Grayson Highlands State Parks) are unlikely to be altered through vegetation management actions. No such cumulative impact can be identified. The Clinch Mountain State Wildlife Management Area does receive a degree of vegetation manipulation, as do many of the privately held lands; especially the private industrial forests in the area. Presumably, these areas would be similar to the Jefferson National Forest Alternatives A, F, and I with respect to the ability to increase the pine component. Thus, activities on privately held lands would slightly increase the amount of pine seed that could be blown onto NFS lands, thereby contributing to a very slight increase in the oak-pine community on NFS lands.

HIGH ELEVATION SPRUCE-FIR FORESTS

This forest is dominated by red spruce (*Picea rubens*) and Fraser fir (*Abies fraseri*). Red spruce begins to occur in stands with northern hardwoods (yellow birch, *Betula lutea*; beech, *Fagus grandifolia;* maple spp. *Acer*; etc.) at elevations around 4,500 feet. It becomes more dominant with increasing elevation, and may be the dominant species between 5,000 and 5,500 feet. Dominance of Fraser fir also increases with elevation. It occurs as low as 4,500 feet in Virginia, and may outcompete the red spruce to form pure stands above 6,000 feet. The northern limit of Fraser fir is Mount Rogers in Virginia. North of this point Fraser fir is replaced with its congener, balsam fir (*Abies balsamea*), in such places as Shenandoah National Park and eastern West Virginia. Common shrub associates of red spruce-Fraser fir are *Rhododendron catawbiense*, *Vaccinium erythrocarpum* and *V. constablaei, Rubus canadensis,* and *Viburnum alnifolium.* The herb layer commonly includes *Oxalis montana, Dryopteris campyloptera, Aster divaricatus, Clintonia borealis, Solidago glomerata, Carex pennsylvanica* and *Maianthemum*

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canadense, as well as a variety of other species. The pure fir forest has many of the same species in the understory, although total species diversity is typically somewhat lower. Both of these communities are characterized by relatively high moisture levels, short growing seasons, acidic soils with low levels of nutrients, and are often subject to strong winds and other extreme weather conditions.

For purposes of this analysis, the following CISC Forest Types are included in this section: Fraser fir (CISC 6), Red spruce-Fraser fir (CISC 7), and Red spruce-Northern hardwood (CISC 17).

Spruce-fir forests are low disturbance systems, with most of the area under forest canopy. Adverse affects caused by air pollution and the non-native balsam woolly adelgid have caused significant mortality of overstory trees in many areas, making quality examples of this community very rare and threatening the persistence of many associated species. Further discussion of these threats is found under the Forest Health section.

There are a number of species with viability concerns associated with the spruce-fir type (Appendix E). These forests support species found nowhere else in the world. Some examples are Fraser fir, the rock gnome lichen *(Gymnoderma lineare)*, and the spruce-fir moss spider (*Microhexura montivaga)*. Fraser fir only occurs naturally in a few isolated islands in western Virginia and North Carolina, and in eastern Tennessee (D. Beck In: Burns & Honkala 1990). The rock gnome lichen is only known from the Great Smoky Mountains (Hale, 1979). The spruce-fir moss spider is one of only two known species in the genus *Microhexura,* and is apparently endemic to the southern Appalachian spruce-fir zone. The forests also provide key habitat for both the Carolina and Virginia northern flying squirrels, *Glaucomys sabrinus coloratus and G.s. fuscus,* respectively. Isolated populations of several birds--the northern saw-whet owl *(Aegolius acadicus),* the black-capped chickadee *(Parus atricapillus)*, the red crossbill *(Loxia curvirostra)* and possibly the olive-sided flycatcher (*Contopus borealis*)--occur at these high elevations and are uncommon or rare elsewhere in the southeast.

Within the Southern Appalachians, the southern extent of this habitat association coincides approximately with the state lines where Tennessee, North Carolina and Georgia come together. The northern extent of the association is roughly coincident with the northern boundary of the Monongahela National Forest. These forests are confined to the highest peaks of Virginia, Tennessee, and North Carolina. They provide a cool, moist habitat similar to the boreal forests found at more northern latitudes. Woodward & Hoffman (in Terwilliger, 1991) postulate that Fraser fir speciated from balsam fir *(Abies balsamea)* during the Pleistocene when the climate warmed and populations were isolated on southern mountain tops.

There are about 85,000 acres of spruce-fir forest in the region (SAMAB 1996:168-169). Of this total, 11,700 acres are on national forests. These stands occur on the George Washington, Jefferson, and Cherokee National Forests, and the National Forests in North Carolina. Of the remainder, 62,700 acres are in other public ownership (mostly National Park Service), and 10,600 acres are in private or corporate ownership. Most of the public land (including 39% of the NFS land) is in late successional stage (81 yrs. +) forests. At the time of the Southern Appalachian Assessment (1996), four percent of the National Forest acres were in the sapling/pole (11-40 yrs.) stage and 57% were in the mid-successional (41-80 yrs.) stage. All of the private holdings are in either the sapling/pole stage or the mid-successional stage.

There are approximately 4,130 acres of spruce-fir forest on the Jefferson National Forest (Table 3-30) or 0.5 percent of total forested acres. Of this, approximately 1,550 acres are designated as core areas for maintenance of the type. The remaining spruce-fir forests are in situations where management for desired ecological conditions within the type would be difficult. Such areas include, but are not limited to: 1) Heavy recreation use areas, such as campgrounds (dispersed or developed) and visitor's centers; 2) "balds" that are maintained by grazing, prescribed fire, manual, mechanical or chemical vegetation management; or 3) inclusions devoted to some form of special use, such as electronic sites.

Table 3-30. Current acres of spruce-fir forests by successional stage

Successional Stage	Acres
Early Successional	0
Sapling/Pole	10
Mid- Successional	3,210
Late-Successional	910
TOTAL	**4,130**

Spruce seedlings are naturally spreading into northern hardwood stands down to elevations of approximately 3,500 feet on northern and eastern aspects within the high country of the Mount Rogers NRA. Other aspects are also being affected similarly but only to somewhat higher elevations. Wet areas along drainages such as Big Wilson Creek, Middle Fork Helton Creek, and Helton Creek have several spruce seedlings now in the understory. Higher peaks and ridges such as Wilburn Ridge, Pine Mountain and Three Peaks are also showing more evidence of primarily Red spruce with little Fraser fir surviving the balsam woolly adelgid. Some areas on Cabin Ridge, where prescribed fire has been excluded, are reverting to spruce. Eventually, this species will become the climax forest on these sites unless climatic changes, insects, or other atmospheric conditions alter that. Dead fir stands are being replaced with Red spruce seedlings through natural reforestation.

MANAGEMENT INDICATORS

Total acres of spruce/fir forests and acres of spruce/fir forest restored will be used as management indicators to assess effects to this community. Because little active management would occur in this type, no management indicator species (MIS) were chosen to reflect effects of management on this community.

Direct and Indirect Effects

Potential negative impacts to this community include recreational activity that may inhibit regeneration because of soil compaction, physical damage to young trees primarily from prescribed fire, and the commitment of some potential tree growing sites to recreational endeavors such as balds management. Fraser fir cone collection or seedling collection is no longer allowed on the Mount Rogers NRA. In response to these threats, forest-wide standards have been incorporated into all alternatives to help maintain this type. Prescribed fire is excluded from selected sections of areas mentioned above where the spruce-fir reforestation is occurring naturally. Some areas and corridors have been selected to replant spruce-fir seedlings for restoration.

On the Jefferson National Forest, core areas of spruce-fir forest lie within the Lewis Fork and Little Wilson Creek wilderness areas as well as Grayson Highlands State Park. Grayson Highlands State Park is not actively maintaining their bald areas, allowing them to revert to red spruce and northern hardwoods through natural means. Almost a thousand acres will become spruce/fir/northern hardwood habitat known to be beneficial to the northern flying squirrel in the future in the State Park. Within Forest Service wilderness, natural successional processes are restoring this forest community. Mature red spruce trees have reached competitive status, extending above the tree tops of other forest types (oaks primarily) and will become the climax forest type for most of these areas in the future under natural means. Threats to this community include possible insect invasions, wildland fire, and the potential for global warming disasters.

Restoration efforts on the Jefferson National Forest would result in various levels of spruce-fir habitat restoration for each alternative as shown in Table 3-31. Generally, restoration management would consist of activities that protect or enhance spruce-fir forests, and conform to the Recovery Plans for listed species. Restoration activities for spruce-fir forests may include planting trees, removing selected trees, and use of herbicides. Activities needed to control insects and diseases are not clearly known at this time. Such activities would be proposed and analyzed as site-specific projects.

The most significant increases in the spruce-fir habitat type occur with Alternatives G, B and D and within areas where spruce is seeding in voluntarily. Alternative G provides for restoration of all bald areas to spruce-fir type. Alternative B provides for restoration of about half of the present bald acreage within the Crest Zone to bald habitat. Alternative D provides for restoration of a spruce-fir corridor between Mount Rogers and Whitetop mountains. Alternatives A, E, and F allow for restoration of a fifteen acre corridor to bridge Mount Rogers and Cabin Ridge and a two acre planting of Red spruce at Whitetop. Alternative I allows for restoration as in Alternatives A, E, and F plus other areas within the Crest Zone along Big Wilson Creek, Middle Fork Helton Creek and on Cabin Ridge.

Table 3-31. Acres of existing spruce-fir forests and acres of former sites to be restored by alternative for the Jefferson National Forest

Alternative	Acres
A	17
B	1,087
D	702
E	17
F	17
G	2,520
I	144

All alternatives protect core areas of spruce-fir habitat. Under all alternatives, areas occupied by red spruce will continue to expand through natural successional processes. Northern flying squirrel habitat use appears to be strongly associated with riparian areas as evidenced from the results of a recent telemetry study in the Mount Rogers/Whitetop areas. These areas are being protected and managed under all alternatives for riparian-dependant and associated species like the northern flying squirrel. These riparian areas are reverting to spruce through natural restoration in significant quantities. Major riparian areas include Little Wilson Creek, Big Wilson Creek, Cabin Creek, Middle Fork Helton Creek, Opossum Creek and their tributaries. Forest Service active management, such as the use of prescribed fires of low intensity, is not hampering the spread of red spruce seedlings within these in damp riparian areas. Here presently expanding young vegetation will provide connective corridors for species such as the northern flying squirrel within the next 100+ years.

Cumulative Effects

Populations of Fraser fir are in decline range-wide because of several threats. The balsam woolly adelgid is slowly killing most of the mature fir. Airborne heavy metal pollution and acid precipitation may be contributing to the decline of both the fir and the spruce and inhibiting regeneration of both species, as well as contaminating understory plants and the soil. Because only 14,700 acres of spruce-fir forest out of a total of 85,000 is privately owned, the perpetuation of this forest type is primarily a federal responsibility. Restoration and maintenance activities on National Forest and expected protection and management on the National Parks should have positive benefits to the type; however, continued decline in quality of these communities is likely due to impacts from the balsam woolly adelgid and air pollution. Therefore, despite national forest management efforts, it is likely that quality examples of this community will continue to decline on the forest and within the Southern Appalachian region.

WOODLANDS, SAVANNAS, AND GRASSLANDS

Complexes of woodlands, savannas, and grasslands were once a frequent occurrence across the southeastern landscape, maintained with frequent fire on xeric ridge-tops and south-facing slopes (DeSelm and Murdock 1993; Davis et al. 2002). Woodlands are open stands of trees, generally forming 25 to 60 percent canopy closure (Grossman et al. 1998:21) and may be of pine, hardwood (typically oak), or mixed composition. Savannas are usually defined as having lower tree densities than woodlands; grasslands are mostly devoid of trees. All of these conditions typically occurred in mixed mosaics within a fire-maintained landscape. In all cases, a well-developed grassy or herbaceous understory is present.

Because existing woodland, savanna, and grassland complexes are rare, do not conform to existing definitions of community types, and are not consistently tracked, the current acreage in such condition is not well documented. This vegetative condition is not a community type in and of itself, but rather, could occupy some sites allocated to other formally defined community types. This vegetative type forms a subset of the oak, oak-pine, and pine-oak forests analyzed in depth elsewhere in this document. The woodlands, savannas, and grasslands are expected to occupy the most xeric sites of the dry and xeric oak forest, woodland, and savanna and the xeric pine and pine-oak forest and woodland community types. These community types are most likely to occupy sites that historically supported woodlands, savannas, and grasslands.

Existing remnants of this habitat and several associated rare species in both the Southern Appalachians and Piedmont are limited primarily to roadsides and powerline rights-of-way (Davis et al. 2002) due to reductions in fire frequency across most landscapes.

Many species of viability concern area associated with this community in both the Southern Appalachians and the Piedmont (Appendix E). Of these, the majority are vascular plants, followed by reptiles, birds, and insects.

MANAGEMENT INDICATORS

Management indicators used to assess management effects to this vegetation type are: 1) the acres burned to restore complexes of woodlands and savannas; 2) acres burned to restore grasslands; and 3) expected impacts to populations of the eastern towhee (*Pipilo erythrophthalmus*), the Management Indictor Species (MIS) chosen to represent desired conditions within this vegetative condition.

Direct and Indirect Effects

Because of their current rarity, existing remnants of grassland communities that support significant populations or assemblages of rare species would be managed under the Rare Community Management Prescription under all alternatives. Similarly, existing woodland conditions associated with glades and barrens also would be included under rare community provisions. The Rare Community Management Prescription provides priority to protection and maintenance of such sites under all alternatives, including regular prescribed burning to maintain desired species composition and vegetation structure. Therefore, these sites are expected to be sustained for the foreseeable future under all alternatives. Populations of the rufous-sided towhee associated with these rare communities would be expected to be maintained under all alternatives.

In an effort to restore some of the ecological role that these communities have historically played, the Forest Plan includes objectives for restoring complexes of woodlands, savannas, and grasslands to fire-maintained landscapes by maintaining a burn cycle of 4-12 years in savannas and woodlands (Objective 18.02) and a cycle of 3-8 years in grasslands (Objective 18.01). Focus of management is on developing the understory rather than the overstory. Desired conditions include heterogeneous canopy coverage averaging 25 to 60 percent with dense grass and herbaceous ground layers. Scattered patches may be devoid of canopy to provide for interspersed savanna and grassland conditions. Restoration activities may include thinning of trees (generally to less than 60 square feet of basal area per acre), prescribed burning, and/or herbicide use. Prescribed fire on relatively short rotations (3 to 12 years) typically would be used to maintain desired conditions, and may involve both dormant and growing season fires.

Because good examples of this community have become rare or missing on today's landscape, abundance of this community type in the future will be directly related to the amount of restoration and maintenance activities accomplished. Acres of woodland, savanna, and grassland complex restored and maintained would vary by alternative as a result of differing management emphases and activity levels. Estimates of acres burned to restore and/or promote woodland, grassland, and savanna habitat were derived for each alternative. These estimates were based on the amount of acres of the appropriate community types located in various Management Prescriptions. Management Prescriptions were rated as to the management opportunity level (none, low, medium, and high) they provide for the levels of prescribed burning desirable for maintenance and restoration of woodlands, savannas, and grasslands. Considering the total acres of appropriate community types in Management Prescriptions that would allow a low, moderate, or high level of prescribed fire and the desired fire return interval, estimates of the annual acres burned to achieve Objectives 18.01 and 18.02 were derived. These values are presented in Table 3-32.

Table 3-32. Expected average annual acres of maintenance and restoration activities for woodland, savanna, and grasslands complexes on the Jefferson National Forest

Activity	Alt A	Alt B	Alt D	Alt E	Alt F	Alt G	Alt I
Average annual acreage prescribed burned to restore woodlands, savannas, and grasslands over 50 year period	5,000	6,300	4,900	3,000	140	5,300	5,000

Alternative B would have the greatest potential for the use of fire in restoration of this vegetative type. Approximately 6,300 acres would be burned in order to restore or promote woodlands, grasslands, and savannas under this alternative. Since restoration of community types is a focus of Alternative B, this alternative is expected to result in the largest increase in woodlands, grasslands, and savanna habitat.

Alternatives A, D, G, and I all rank very closely to one another in terms of the acres expected to be burned in meeting Objectives 18.01 and 18.02. Acres burned for these purposes range from 4,900 (Alternative D) to 5,300 (Alternative G). This variation is quite minimal and would not be expected to result in large differences of restored woodlands, grasslands, and savannas between the alternatives.

Alternative E would only result in about 3,000 acres burned and Alternative F in about 140 acres burned. Neither alternative is expected to greatly support restoration of the woodland, grassland, or savanna vegetative condition.

Restoration and maintenance activities would provide habitat for species included within this habitat association, including the community MIS and rufous-sided towhee. Populations of these species are expected to vary across alternatives based on the amount of habitat restored and maintained.

Alternative B is expected to benefit this species the most since it would focus on restoration of the very habitat, among others, that this bird indicates. Alternatives A, D, G, and I would also benefit this bird species, but the acres of management activities restoring this birds preferred habitat are less than for Alternative B. Finally, populations of the species would be expected to remain stable as compared to present abundance under alternatives E and F given their estimated number of acres burned to restore woodland, grassland, and savanna habitat.

Restoration and maintenance activities may cause some short-term negative effects to individual MIS and other associated species, by causing disturbance, mortality, or temporarily setting back plant and animal reproduction or growth. However, species associated with this community are adapted to such disturbances, which are necessary to create and maintain optimal habitat conditions. In balance, these actions would result in beneficial effects to associated species.

Cumulative Effects

Restoration and management activities on National Forests would play a critical role in the conservation of this community within the landscapes containing national forest land. Natural woodland, savanna, and grassland habitats are currently rare, occurring on private, other Federal (Blue Ridge Parkway), and State ownerships primarily along mowed roadside and powerline rights-of-ways (Davis et al. 2002). It is not expected that private landowners and/or other agencies such as the National Park Service or Virginia Department of Game and Inland Fisheries will restore or manage to maintain significant amounts of woodland, savanna, and grassland complexes; therefore, they would remain limited in abundance without national forest restoration efforts.

RARE COMMUNITIES

INTRODUCTION

Rare Communities and other special biological areas on the Jefferson National Forest were identified through a cooperative effort between the Forest and the Virginia Department of Conservation and Recreation, Division of Natural Heritage (VA-DCR-NH). VA-DCR-NH submitted two main reports summarizing areas needing special management for this Forest Plan Revision process, one in April 1996 and another in July 2000. In addition, several interim reports were also provided. These reports contain a listing of heritage resources found in each area, a site description, identified threats to the area, management recommendations, protection recommendations, and VA-DCR-NH's rationale for the boundary of the areas depicted on accompanying maps. All areas have a protective buffer included within the boundary, so acres shown include this buffer.

These maps were digitized by Jefferson National Forest personnel and used for allocation of Management Prescription 9F-Rare Communities, as well as Management Prescription 4D-Special Biological Areas. Special Biological Areas contain one or more rare species (but not a rare community) and are discussed in another section of this document.

Table 3-33 displays the areas identified by their broad community classification. Several areas contain more than one rare community. These areas are identified by the title "Rare Community Assemblage." The acres shown are for the entire area, not individual rare communities, and as already mentioned, also include acres of protective buffer.

BIOLOGICAL ENVIRONMENT

RARE COMMUNITIES

Table 3-33. Rare Communities on the Jefferson National Forest

Glades, Barrens, and Woodlands Area Name	JNF Acres
Bald Mountain Sandstone Glades	140
Bessemer Barren	10
Broad Run Barren	18
Bryant Gap	486
County Line Barrens	49
Cove Mountain	141
Forest Road 462 Barrens	74
Furnace Mountain	56
Given Barren	25
Hanging Rock Hollow	42
Horton Barren	57
Jennings Creek Shale Barren	43
Lick Branch Barrens	49
Little Patterson Creek Barren	42
Little Stone Mountain	1,167
Maggie Shale Barren	31
Mudlick Branch Woodland	10
North Creek Woodland	39
Patterson Creek Barren	81
Patterson Mountain Barren	33
Raven Cliff	775
Roadcut Barren	5
Sarver Barrens	154
Sevenmile Mountain	187
Sinking Creek Mountain	207
Sprouts Run	142
Skegg Woodlands	206
Staunton Creek Gorge	353
Surber Barren	31
Trout Creek Shale Barren	13
Upper Skegg Spur	25
Whitetop Laurel Slopes	63
Basic Mesic Forest Area Name	
Dismal Creek	619
Little Stone Mountain	1,167
Lovelady Coves	35
Staunton Creek Gorge	353
Beech Gap Forest Area Name	
Mount Rogers	3,936
High Elevation Balds Area Name	
Whitetop Mountain	1,090

Mountain Wetlands Area Name	JNF Acres
Big Wilson Creek	578
Chimney Cliffs and Russell Fork	368
Day Creek Pond	13
Dismal Creek	619
Glady Fork Beaver Meadow	821
Hagen Hall Sinkhole Pond	19
Indian Grave Gap	373
Interior Seep	94
James Riverside Prairie	83
Kelly Knob-Big Pond	592
Little Wilson Creek Headwaters	464
N. Fork Stony Creek	259
Potts Cove	349
Potts Pond	26
Pound River	101
Salt Pond Mountain	1,310
Tazewell Beartown	788
Rock Outcrops and Cliffs Area Name	
Camp Rock	7
Chimney Cliffs and Russell Fork	368
Cliff Mountain	2,673
James River Gorge	8,922
Mount Rogers	3,936
Raven Cliff	775
Caves and Mines Area Name	
Cave Springs Cave	166
Cliff Mountain	1,603
Little Stone Mountain	1,167
Pine Mountain Tunnel	206
Shires Saltpetre Cave	381
Staunton Creek Gorge	353
Stone Mtn/Powell Mtn Cliffs	318
Spruce-Fir Forest Area Name	
Mount Rogers	3,936
Tazewell Beartown	788
Whitetop Mountain	1,090
Carolina Hemlock Forest Area Name	
Raven Cliff	775
TOTAL Number of Areas	**59**
TOTAL JNF Acres[1]	**28,275**

[1] Not all of these acres are actual rare communities, they include buffer areas as well. Approximately 15,000 acres are within existing Wilderness areas.

GLADES, BARRENS, AND ASSOCIATED WOODLANDS

These communities are characterized by thin soils and exposed parent material that result in localized complexes of bare soils and rock, herbaceous and/or shrubby vegetation, and thin, often stunted woods. During wet periods they may include scattered shallow pools or areas of seepage. Glades, barrens, and associated woodlands differ from rock outcrop communities by exhibiting soils and vegetative cover over the majority of the site, and differ from the more widespread woodland communities in that they occur on geologic substrates which are unique for the region, including limestone, dolomite, amphibolite, greenstone, mafic rock, serpentine, sandstone, or shale. Associated communities include Calcareous Woodlands and Glades, Mafic Woodlands and Glades, Serpentine Woodlands and Glades, and Shale Barrens as defined in the Southern Appalachian Assessment (SAMAB 1996). At minimum, this rare community complex includes rare associations within the following ecological groups as defined by NatureServe (2001a):

401-17 Appalachian Highlands Calcareous/Circumneutral Dry-Mesic Hardwood Forest

440-05 Appalachian Highlands Carbonate Glades and Barrens

440-10 Interior Highlands Carbonate Glades and Barrens

440-25 Appalachian Sandstone Glades and Barrens

440-80 Appalachian Mafic Igneous/Metamorphic Glades and Barrens

The following descriptions of glades, barrens and associated woodlands on the Jefferson National Forest comes from Fleming and Coulling (2001) and uses their classification:

CENTRAL APPALACHIAN SHALE BARRENS

A variable group of sparse woodlands, shrublands, and open herbaceous rock outcrops occurring on Ridge and Valley shales and Blue Ridge metashales of the Central Appalachian Mountains. These small-patch communities range from western Virginia and eastern West Virginia to southern Pennsylvania. In Virginia, they occur at elevations from 850 to 3,040 feet. Although stunted trees of several species (*e.g.*, *Quercus prinus*, *Pinus virginiana*, and *Carya glabra*) are common, shale barrens are strongly characterized by their open physiognomy and by a suite of uncommon to rare plants found almost exclusively in these habitats. Endemic or near-endemic shale barren species include *Arabis serotina*, *Clematis albicoma*, *Clematis viticaulis* (also endemic to Virginia), *Eriogonum allenii*, *Oenothera argillicola*, *Packera antennariifolia* (= *Senecio antennariifolius*) and *Trifolium virginicum*. Habitats generally occur on steep (~ 30 degree) slopes with south to west aspects. The steep, xeric slopes and friable nature of the shale create poorly vegetated hillsides of bare bedrock and loose channery visible from afar. Continual undercutting of thick but relatively weak shale strata by streams maintain shale barrens. Less common, densely graminoid-dominated variants occurring on steep spur ridge crests and mountain summits are sometimes referred to as “shale ridge balds.” Shale barrens are considered globally uncommon and host many locally rare species including the butterflies Appalachian grizzled skipper (*Pyrgus wyandot*) and Olympia marble (*Euchloe olympia*) and the federally listed plant *Arabis serotina*. The primary threat to these communities is probably invasion by non-native invasive species, but examples of these communities near roads are also threatened by quarrying.

Examples:

- Central Appalachian shale barren-Maggie shale barren, New River Valley
- Central Appalachian shale barren-Furnace Mt., Glenwood

- Central Appalachian shale barren-Sprouts Run, Glenwood
- Central Appalachian shale barren-North Creek woodland, Glenwood
- Central Appalachian shale barren-Hanging Rock Hollow, Glenwood
- Central Appalachian shale barren (2)– James River Gorge, Glenwood
- Central Appalachian shale barren-Little Patterson Creek shale barren, New Castle
- Central Appalachian shale barren-County Line shale barrens, New Castle
- Central Appalachian shale barren-Broad Run barren, New Castle
- Central Appalachian shale barren-Craig Creek Barren SIA, New Castle
- Central Appalachian shale barren-Sarver barrens, New Castle
- Central Appalachian shale barren-Surber barren, New Castle

MONTANE ACIDIC WOODLANDS

These communities include coniferous, mixed, or less commonly deciduous woodlands of xeric, edaphically stressful habitats. Communities in this group are scattered throughout the Virginia mountains and occupy somewhat heterogeneous habitats that are characterized by shallow, drought-prone, highly oligotrophic soils. These include barren, acidic shale slopes and crests in the Ridge and Valley and Northern Blue Ridge provinces; sandstone outcrops and pavements in the Ridge and Valley and Cumberland Mountains; and xeric, low-elevation terrain formed on massive alluvial fans along the western foot of the Blue Ridge. Pines, including *Pinus virginiana*, *Pinus rigida*, and *Pinus echinata* are characteristic canopy trees in several environmental / compositional variants. *Quercus prinus*, *Quercus stellata*, *Quercus marilandica*, and *Quercus ilicifolia* are widespread oak components. In some cases, Montane Acidic Woodlands are floristically similar to Pine-Oak/Heath Woodlands but are maintained primarily by drought stresses associated with outcrop environments rather than by fire. They also tend to have a sparser representation of heath shrubs and a more diverse herb layer, with a larger component of graminoids such as little bluestem (*Schizachyrium scoparium*) or Pennsylvania sedge (*Carex pensylvanica*). At least some of the community types in this group appear to be state- or globally rare, but their relationship to vegetation on a regional scale needs further investigation.

Examples:

- Low elevation acidic outcrop barren-Bald Mt., New Castle
- Low elevation acidic outcrop barren-Cove Mt., New River Valley
- Low elevation acidic outcrop barren-Osborne Ridge, Clinch
- Low elevation acidic outcrop barren-Skegg woodlands, Clinch
- Low elevation acidic outcrop barren (3)-Bryant Gap, Clinch
- Oak-hickory woodland/savanna (Typic subtype)- Skegg woodlands, Clinch

MONTANE DRY CALCAREOUS FORESTS AND WOODLANDS

These communities are deciduous or occasionally mixed forests and woodlands of mostly subxeric, fertile habitats over carbonate formations of limestone or dolomite. Habitats are steep, usually rocky, south- to west-facing slopes at elevations from < 1,000 to 2,900 feet. Soils vary from circumneutral to moderately alkaline, and have high calcium levels. Confined in Virginia to the mountains, these communities are most frequent and extensive in the Ridge and Valley, but occur locally in both the Blue Ridge and Cumberland Mountains. Tree canopies vary from nearly closed to sparse and woodland-like. Overstory mixtures of *Quercus muehlenbergii*, *Acer saccharum*, *Acer nigrum*, *Quercus rubra*, *Quercus alba*, *Quercus shumardii*, *Fraxinus americana* are typical. These forests and woodlands share many understory and herbaceous plants with the Piedmont / Mountain

Basic Woodlands group and are similarly species-rich. A few of the taxa that are confined to or most important in the limestone and dolomite communities include *Frangula caroliniana*, *Packera obovata* (= *Senecio obovatus*), *Erigeron pulchellus*, *Diarrhena americana*, *Muhlenbergia tenuiflora*, *Piptatherum racemosum (= Oryzopsis racemosa)*, *Carex purpurifera* (in extreme southwestern Virginia only), *Helianthus hirsutus*, *Helianthus microcephalus*, and *Zigadenus elegans* spp. *glaucus*. Much compositional variation is evident in these communities across western Virginia.

Examples:

- Dry calcareous forest/woodland (Montane subtype) (2)-Stone Mt./Powell Mt. Cliffs, Clinch
- Dry calcareous forest/woodland (Montane subtype)-Cliff Mt., Clinch
- Dry calcareous forest/woodland (Montane subtype) (2)-Little Stone Mt., Clinch
- Dry calcareous forest-Staunton Creek Gorge, Clinch
- Dry calcareous forest-Little Stone Mt., Clinch
- Dry calcareous forest-Raven Cliff, Mount Rogers National Recreation Area

LOW ELEVATION BASIC OUTCROP BARRENS

Scrub and herbaceous vegetation of exposed, base-rich outcrops in the Piedmont and mountain regions make up this community type. The majority of documented occurrences are on mafic (diabase, amphibolite, gabbro) outcrops of the Piedmont and Southern Blue Ridge, and metabasalt (greenstone) outcrops of the northern Piedmont and Blue Ridge. A few examples on granitic rocks and calcareous sandstone have also been documented. Habitats generally have a high cover of exposed bedrock, but often have more extensive organic or soil mats, and thus more vascular plant cover, than do acidic outcrops. Soils usually consist of thin veneers and vary from strongly acidic to circumneutral, with moderately high base status. Vegetation is usually a patchwork of stunted trees, shrub thickets, herbaceous mats, and lithophytic lichens. Typical woody species include *Fraxinus americana*, *Juniperus virginiana*, *Chionanthus virginicus*, *Physocarpus opulifolius*, *Rhus aromatica*, and *Ptelea trifoliata*. Typical herbs include *Allium cernuum*, *Talinum teretifolium*, *Polygonum tenue*, *Helianthus divaricatus*, *Cheilanthes lanosa*, *Woodsia ilvensis*, *Schizachyrium scoparium*, *Muhlenbergia capillaris*, *Asclepias verticillata*, *Phacelia dubia*, and *Heuchera americana*. These small-patch communities are rare in Virginia and globally. Perhaps because of their more fertile substrates, basic outcrop barrens are more prone to invasion by non-native invasive weeds than are acidic barrens.

Examples:

- Low elevation basic outcrop barren-Millers Yard, private land near Clinch District.

MONTANE BASIC WOODLANDS

These communities include deciduous and mixed woodlands of xeric, rocky habitats over mafic substrates such as diabase, gabbro, metabasalt (greenstone), and amphibolite. A few examples of this group occur in habitats underlain by base-rich granite, calcareous shale, and calcareous sandstone. Occurrences in Virginia are widely and locally scattered throughout the Piedmont and mountains, often occurring in patch-mosaics with exposed outcrop barrens. They are most frequent (but still very local) in greenstone districts of the Northern Blue Ridge. Habitats are situated on south- to west-facing slopes with numerous outcrops and shallow, rocky soils that are dry but relatively fertile, with moderately high levels of calcium and magnesium. Although *Quercus* spp. are frequent (sometimes dominant) components, these woodlands are more often dominated by variable mixtures of *Fraxinus americana* and *Carya* spp., often with *Juniperus virginiana* or *Pinus virginiana* as a major associate. Trees are usually somewhat stunted and form an open or sparse canopy. Typical small trees and shrubs include *Cercis canadensis*, *Ostrya virginiana*, *Physocarpus opulifolius*, *Rhus aromatica*, *Celtis occidentalis*, *Celtis tenuifolia*, *Ulmus rubra*, and *Ptelea trifoliata*. These woodlands contain a surprisingly diverse array of herbaceous graminoids and forbs; a few of the more widespread, representative species are *Muhlenbergia sobolifera*, *Solidago ulmifolia*, *Elymus hystrix*, *Carex pensylvanica*, and *Pycnanthemum incanum*. There are few threats to these communities, although the shrub *Symphoricarpos orbiculatus*, introduced from farther west, is a troublesome invasive in some stands.

Examples:

- Montane basic woodland (2)-Bryant Gap, Clinch
- Montane basic woodland-Whitetop Laurel slopes, Mount Rogers National Recreation Area

PINE-OAK /HEATH WOODLANDS

Species-poor, fire-influenced, mixed woodlands of xeric exposed mountain habitats compose these communities. Sites are typically located on convex, south to west faces of steep spur ridges, narrow rocky crests, and cliff tops. Pine–oak/heath woodlands are widespread throughout both the Ridge and Valley and Blue Ridge provinces in western Virginia. They occur at elevations from below 1,000 feet to more than 4,000 feet on various substrates, but most commonly on acidic, sedimentary and metasedimentary substrates, *e.g.*, sandstone, quartzite, and shale. A few stands occur on Piedmont monadnocks and foothills. Soils are very infertile, shallow, and droughty. Thick, poorly decomposed duff layers, along with dead wood and inflammable shrubs, contribute to a strongly fire-prone habitat (Groeschl et al. 1992). Short-statured *Pinus pungens* and *Pinus rigida* are usually dominants forming an open canopy, often with co-dominant *Quercus prinus*. Less important tree associates include *Quercus coccinea*, *Pinus virginiana*, and *Sassafras albidum*. Except in the Piedmont stands, *Quercus ilicifolia* is characteristic (often abundant) in the shrub layer, along with various ericaceous shrubs. Colonial shrubs usually pre-empt available microhabitats for most herbaceous species, but *Pteridium aquilinum* var. *latiusculum* and the spectacular *Xerophyllum asphodeloides* are often competitive enough to achieve significant cover. Periodic fire is an important ecological process that provides opportunities for regeneration of both pines and less competitive herbaceous species, while setting back successional encroachment of potential canopy oaks (especially *Quercus prinus*). On cliffs and other very rocky sites, the vegetation is self-perpetuating due to extreme edaphic conditions. Fire reduction and the insect pest, southern pine beetle (*Dendroctonus frontalis*) are the most serious threats to communities of this group. The state-rare northern pine snake (*Pituophis melanoleucus melanoleucus*) and several rare moths (all bear oak feeders) are locally associated with these woodlands.

Examples:

- Pine-oak/heath woodland-Indian Grave Gap, Clinch
- Pine-oak/heath woodland-Lignite overlook, New Castle

These communities may be found in the Appalachian and Piedmont regions. Limestone or dolomite, and sandstone glades and barrens occur primarily in the Ridge and Valley physiographic provinces ranging from Northern Alabama to Kentucky. Good examples are few and very restricted in distribution. Serpentine glades are known primarily from the Nantahala National Forest in North Carolina. Shale and mafic woodlands are more widespread in distribution, and may be forested if fire has not played a role in their maintenance or restoration. Most occurrences for mafic associations are from the Piedmont, but may occur as high as 3,800 feet in elevation. Most shale woodlands are in the Carolina Slate Belt in Georgia, North Carolina, and South Carolina, but neither shale nor mafic woodlands have been well inventoried.

The Southern Appalachian Assessment (1996) concluded that only 25% of the known occurrences for species associated with mafic and other calcareous habitats, occurred on National Forest system lands.

Currently, inventory information for these communities is incomplete. Though underlying soils may differ from the surrounding soils in exchangeable nutrient capacity or pH, they may be overlooked in mapping efforts since they often occur as small inclusions within larger stands. To achieve desired composition and structure within these communities, many will require active restoration, such as basal area reduction, woody understory and mid-story control, or prescribed fire. Prescribed fire will often be needed to maintain these communities once restored.

Direct and Indirect Effects

Glades, barrens, and associated woodlands are identified under all Forest Plan revision alternatives as rare communities to be protected, restored, and maintained under the rare community prescription. Many examples of this type are likely to be overgrown or in need of some level of restoration. Some negative short-term effects to individual plants and animals associated with these communities could occur as a result of active restoration activities, which may temporarily alter the timing of reproduction or growth. Short-term negative effects to species associated with these communities are expected to be small and discountable compared to the long-term positive benefits of habitat restoration activities. Because all rare communities would be managed under the rare community (9F) prescription, and the standards associated with the rare community prescription would be applied, effects of National Forest management on both the communities and associated species is expected to be positive across all alternatives in the long-term.

Although the glade and barren communities are naturally restricted in distribution by soil conditions, under the rare community prescription all occurrences would be managed for restoration and maintenance of their characteristics. This emphasis is expected to result within 50 years in an abundance and distribution of this community on the Jefferson National Forest similar to that which occurred historically.

Cumulative Effects

Cumulative effects on the quantity and distribution of these rare communities are predicted by considering opportunities to inventory and restore these communities across alternatives and across private and public ownerships. Ability to protect and restore these communities on the National Forest is limited by knowledge regarding their occurrence and distribution on the landscape. If only 25% of the known sites for this community type occur on National Forest land, where management would be optimal, the majority of glades, barrens, and associated woodlands on the landscape likely occur on private lands where they may be vulnerable to development, competition with successional vegetation, and extirpation. Given the emphasis on rare communities under all Forest Plan revision alternatives, our knowledge regarding their distribution on National Forest land is likely to increase. This outcome suggests that the National Forest will play a larger role than private land in the conservation of glades, barrens, and associated woodlands in the future. Cumulatively, effects of Forest Plan revision implementation are likely to be critical to the maintenance of this community and associated rare species. The importance of national forest management is expected to increase with time, as national forest inventories and restoration efforts improve and private land examples of the community are subject to increasing pressures or neglect.

RARE MOUNTAIN WETLAND COMMUNITIES

It is estimated that more than 50% of the Nation's wetlands have been destroyed in the past 200 years (Ernst and Brown 1988). They are vulnerable to destruction on private land and, therefore, it is critical to maintain these communities where they occur on national forest land. Wetlands have been ditched and drained for pastures, mined for peat (Ewel 1990), and filled for shopping centers. Loss of some wetlands can also be attributed to sedimentation, pollution, and plant succession due to fire suppression (USFWS 1991). Beaver activity has historically played an important role in creating open wetland habitats that are now rare on the landscape. Beaver wetlands are beneficial for many rare species such as monkey face orchid (Shea 1992), but may be detrimental to others such as bog turtle (Jensen, personal communication). Beaver impoundments also may cause unacceptable impacts to facilities and other resources.

Rare mountain wetland communities in the Southern Appalachians and Piedmont include bogs, fens, seeps, ponds, river gravel-cobble bars, and river scour areas as defined in this section.

APPALACHIAN HIGHLANDS BOGS, FENS, SEEPS, AND PONDS

Bogs, fens, seeps, and ponds may be found in both the Appalachian and Piedmont regions, and are characterized by: 1) soils that are semi-permanently to permanently saturated as a result of groundwater seepage, perched water tables, rainfall, or beaver activity, but otherwise are generally nonalluvial; and 2) presence of wetland-associated species such as sphagnum, ferns, and sedges. Dominant vegetation may be herbs, shrubs, trees, or some complex of the three. Ponds in this group include limesink, karst, and depression ponds, which may hold areas of shallow open water for significant portions of the year. Also included are all impoundments and associated wetlands resulting from beaver activity. Artificial impoundments are not included, unless they support significant populations or associations of species at risk. The primary management need is that of protection from activities that could disrupt wetland hydrology or other community structures and functions. Some sites may require periodic vegetation management to maintain desired herbaceous and/or shrubby composition. Rare mountain wetland communities include Mafic and Calcareous Fens, Sphagnum and Shrub Bogs, Swamp Forest-Bog Complex, Mountain Ponds, Seasonally Dry Sinkhole Ponds, and Beaver Pond and Wetland Complex as defined in the Southern Appalachian Assessment (SAMAB 1996), and all Associations within the following Ecological Groups as defined by NatureServe (2001):

458-15 Appalachian Highlands Wooded Depression Ponds

458-20 Appalachian and Interior Highlands Limesink and Karst Wooded Ponds

470-10 Appalachian Highlands Forested Bogs

470-20 Appalachian Highlands Forested Acid Seeps

470-50 Appalachian Highlands Forested Fens and Calcareous Seeps

475-10 Appalachian Highlands Acid Herbaceous Seeps

475-20 Appalachian Highlands Alkaline Herbaceous Fens and Seeps

475-30 Appalachian and Interior Highlands Herbaceous Depression Ponds and Pondshores

APPALACHIAN HIGHLANDS RIVERINE VEGETATION

Riverine rare communities are characterized by: 1) sites adjacent to or within stream channels that are exposed to periodic flooding and scour; and 2) presence of significant populations or associations of species at risk. These communities may be found in both Appalachian and Piedmont regions. Primary management needs are protection from disturbance during development of road crossings and maintenance of desirable in-stream flows. These communities include River Gravel-Cobble Bars as defined in the Southern Appalachian Assessment (SAMAB 1996), and the rare Associations within the following Ecological Groups as defined by NatureServe (2001):

457-10 Appalachian Highlands Riverine Vegetation

457-30 Rocky Riverbeds

457-40 Appalachian Highlands Riverscour Vegetation

The SAA Terrestrial Report summarizes the approximate number of occurrences of some of these wetland communities on National Forest System lands in the Southern Appalachians (SAMAB 1996: 190). On the Jefferson National Forest there are 20 known occurrences of wetland rare communities documented in the Virginia Department of Conservation and Recreation database (Virginia Department of Conservation and Recreation 1999).

The Virginia Division of Natural Heritage has identified the following rare mountain wetland community types (using their community classifications) on the Jefferson National Forest (Fleming and Coulling 2001):

HIGH ELEVATION SEEPAGE SWAMPS

These communities include saturated, coniferous or mixed forests of gently sloping stream headwaters, large spring seeps, and ravine bottoms at elevations above 3,000 feet. These communities are locally scattered in the higher mountains of western Virginia on various geologic substrates and soils, almost all of which are strongly to extremely acidic. Habitats feature pronounced hummock and hollow microtopography, with braided streams, muck-filled depressions, and lush bryophyte cover. *Tsuga canadensis*, *Betula alleghaniensis*, and *Acer rubrum* are the most common trees. Locally, *Picea rubens* or *Pinus strobus* may be co-dominants. Shrub layer composition and density is variable; deciduous hollies (*Ilex verticillata* and *Ilex montana*), several blueberries (particularly *Vaccinium corymbosum*, *Vaccinium simulatum*, and *Vaccinium angustifolium*), *Rhododendron maximum*, *Kalmia latifolia*, *Alnus incana* spp. *rugosa*, and *Hamamelis virginiana* may be abundant. Characteristic herbs of these swamps include *Caltha palustris*, *Carex echinata*, *Carex leptonervia*, *Carex scabrata*, *Carex trisperma*, *Cinna latifolia*, *Doellingeria umbellata* (= *Aster umbellatus*), *Glyceria melicaria*, *Oclemena acuminata* (= *Aster acuminatus*), *Osmunda cinnamomea*, *Veratrum viride*, and *Viola macloskeyi* spp. *pallens*. Communities in this group are naturally rare due to the scarcity of flat or gentle, wet habitats in the higher Appalachians. Beavers have partially destroyed fine examples of these swamps at several sites.

Example:

- Southern Appalachian swamp forest-bog complex (Typic type)-Potts Mtn./Maple Flats Branch Headwaters, (Potts Cove Rare Community Assemblage) New River Valley
- Southern Appalachian swamp forest-bog complex (Typic type)-Salt Pond Mtn., New River Valley
- Southern Appalachian swamp forest-bog complex (Typic type)-Lower Big Wilson Creek, Mount Rogers National Recreation Area
- High-elevation hemlock-yellow birch seepage swamp-Camping Ridge, Glenwood
- High-elevation hemlock-yellow birch seepage swamp-Thunder Hill, Glenwood

MOUNTAIN PONDS

These communities include seasonally to semipermanently flooded shrub and herbaceous vegetation of basin wetlands situated on broad ridge crests, landslide benches and, more rarely, mountain-foot alluvial fans of the Ridge and Valley and Blue Ridge provinces. These very rare natural ponds range up to about one acre in size and are thought to have formed from the sagging or solution of underlying bedrock strata. Hydrologic regime is variable from pond to pond, and many sites exhibit pronounced seasonal water-level fluctuations. Most mountain ponds are open or partly shaded by trees rooted in drier marginal soils. Vegetation structure varies from shrubland to herbaceous or comprises a patch-mosaic of the two; composition often exhibits distinct concentric zonation. Characteristic plants of semipermanently flooded ponds or zones include *Cephalanthus occidentalis*, *Dulichium arundinaceum*, *Sagittaria latifolia*, *Scirpus ancistrochaetus*, *Carex vesicaria*, and *Utricularia* spp. Species more typical of seasonally flooded ponds or zones include *Ilex verticillata*, *Vaccinium corymbosum*, *Smilax rotundifolia*, *Bidens discoidea*, *Carex stricta*, *Glyceria acutiflora*, *Hypericum mutilum*, and *Juncus* spp. Mountain ponds are important breeding habitats for amphibians and odonates (dragonflies and damselflies). Many of the known occurrences are protected on U.S. Forest Service land, but several privately owned ponds remain vulnerable to anthropogenic disturbances.

Examples:

- Montane herbaceous pond-(2) –Salt Pond Mountain, New River Valley
- Montane buttonbush pond-Big Pond, Kelly Knob, New River Valley
- Montane buttonbush pond-Day Creek, Glenwood
- Montane buttonbush pond-Potts Pond, New Castle

SINKHOLE PONDS

Depressions formed by the solution of carbonate rock that may be part of a karst system comprise these communities. Retention of water is the result of a restricted outlet or a lining of alluvial material that retards outflow of water. Sinkholes are associated with limestone geology that is limited on the Forest. Many sinkholes on private land have been altered, filled or used as trash dumps. See the Mountain Ponds section.

Example:

- Sinkhole Pond-Hagan Hall, Clinch

CALCAREOUS FENS AND SEEPS

These communities are composed of shrub and herbaceous wetlands of calcareous hillside or foot-slope spring seeps and seepage zones in small stream bottoms. These small-patch wetlands are widely scattered in carbonate rock districts of western Virginia, primarily in valleys of the Ridge and Valley province. Habitats typically have irregular or hummock-and-hollow microtopography, with areas of muck and abundant gravel or travertine marl deposits in the seepage rills. Soils, which are derived from underlying limestone or dolomite, are slightly acidic to moderately alkaline with high calcium levels. Strictly defined, fens are minerotrophic wetlands with organic soils > 40 centimeters deep. Because they usually have only superficial organic soil layers, most of the Virginia communities in this group are technically “seeps,” although we retain the term “fen” due to its wide application to various base-rich seepage wetlands in the southeastern United States; see Weakley and Schafale (1994) for additional discussion. The vegetation of these wetlands is often a patch-mosaic of shrubs and herbaceous openings. Common shrubs include *Salix* spp., *Alnus serrulata*, *Rosa palustris*, *Rhamnus alnifolia*, and *Photinia* (= *Aronia*) spp. Herbaceous species that are more or less diagnostic of calcareous fens or seeps include *Carex flava*, *Carex hystericina*, *Carex interior*, *Carex suberecta*, *Cypripedium reginae*, *Juncus brachycephalus*, *Liparis loeselii*, *Parnassia grandifolia*, *Pedicularis lanceolata*, and *Rhynchospora capillacea*. The ecological factors that keep fens and seeps open are not well understood, and many examples appear to be threatened by shrub and tree invasion. Ditching, grazing, and non-native invasive weeds are additional threats to these naturally rare mountain wetlands. Calcareous fens are extremely rare on the Forest and are high priorities for conservation.

Example:

- Central Appalachian calcareous shrub fen/seep (3)– Dismal Creek, New River Valley

MONTANE BASIC SEEPAGE SWAMPS

These communities contain saturated deciduous forests of gently sloping stream headwaters, large spring seeps, and lateral areas in ravines and stream bottoms where groundwater emerges at the base of slopes. These communities are locally scattered throughout western Virginia in areas underlain by metabasalt (greenstone), base-rich granite, calcareous shale, and limestone. Habitats usually have considerable cover of bouldery, cobbly, and gravelly alluvium, braided seeps and stream channels, moss (except *Sphagnum*)-covered hummocks, and muck-filled depressions. Soils range from strongly acidic to circumneutral, with moderately high calcium and magnesium levels. Tree layers are mixed; with variable combinations of *Acer rubrum*, *Fraxinus americana*, *Fraxinus nigra*, *Liriodendron tulipifera*, and *Betula* spp. *Lindera benzoin* is usually the most abundant shrub. Herbaceous cover is usually lush, and often features patch-dominance of *Symplocarpus foetidus*, *Veratrum viride*, and/or sedges, especially *Carex bromoides* and *C. prasina*. Additional characteristic herbs include *Caltha palustris*, *Chrysosplenium americanum*, *Saxifraga pensylvanica*, *S. micranthidifolia*, *Viola cucullata*, and various ferns. Most Virginia populations of the globally rare grass *Poa paludigena*, as well as of the globally rare Blue Ridge Mountain amphipod (*Stygobromus spinosus*), are associated with these swamps. This community is rare on the Forest.

Example:

- Montane Basic Seepage Swamp-Dismal Creek, New River Valley

APPALACHIAN BOGS

These communities have saturated shrub and herbaceous vegetation of gently sloping, groundwater discharge zones along valley floors and headwaters streams in the mountain region of Virginia. Habitats supporting bogs are usually less than one acre in size but rarely range up to 10 acres in the Southern Blue Ridge (Mount Rogers area). Fewer than twenty occurrences have been documented in the state. Soils, which vary from mineral to superficial or deep peat, are extremely acidic and support thick growths of *Sphagnum* and other mosses. The term "bog," as applied to these wetlands, is a technical misnomer, since not all of these habitats are true peatlands and none is an ombrotrophic system. This term, however, is now so widely used in the southeastern United States as a descriptor for open, acidic seepage wetlands that we have adopted it here for consistency; see Weakley and Schafale (1994) for additional discussion. The ecological dynamics of these naturally rare communities are not well understood, and many examples are currently suffering from shrub and tree invasions. Factors that may have been responsible for creating and maintaining open bogs include fire, grazing, beavers, and deep deposition of unstable soils. Bog vegetation is frequently a mosaic of shrub patches and herbaceous openings. Several compositional variants associated with geography and elevation have been documented in Virginia. Species common to most variants include *Rhododendron maximum*, *Rhododendron catawbiense*, *Salix sericea*, *Alnus serrulata*, *Osmunda cinnamomea*, *Eriophorum virginicum*, *Carex atlantica*, and *Rhynchospora capitellata*. Species more restricted to low-elevation (below 3,000 feet) bogs of the Ridge and Valley and Cumberland Mountains include *Drosera rotundifolia*, *Andropogon glomeratus*, *Calopogon tuberosus*, *Platanthera ciliaris*, and *Calamagrostis coarctata*. Species more restricted to higher-elevation (mostly above 3,000 feet) bogs of the Southern Blue Ridge, Allegheny Mountains, and/or the highest mountains of the Ridge and Valley include stunted *Picea rubens*, *Ilex collina*, *Viburnum nudum* var. *cassinioides*, *Kalmia carolina*, *Vaccinium macrocarpon*, *Solidago patula*, *Chelone cuthbertii*, *Solidago uliginosa*, *Carex echinata*, *Sparganium erectum* ssp. *stoloniferum*, *Epilobium leptophyllum*, *Juncus brevicaudatus*, *Carex trisperma*, *Carex ruthii*, and *Houstonia serpyllifolia.*

Example:

- Appalachian bog-Interior Seep, New River Valley
- Appalachian bog-Salt Pond Mtn., New River Valley
- Appalachian bog-Mt. Rogers-Whitetop Rare Community Assemblage, Mount Rogers National Recreation Area
- Appalachian bog-Potts Cove, New Castle

MOUNTAIN/PIEDMONT ACIDIC SEEPAGE SWAMPS

These communities have saturated deciduous forests of gently sloping stream headwaters, large spring seeps, and ravine bottoms underlain by sandstone, quartzite, or base-poor granite. Certain basin wetlands that are saturated or seasonally saturated by perched groundwater support similar vegetation and probably belong in this group as well. These communities are locally scattered throughout the western Virginia mountains and Piedmont foothills, up to about 3,000 feet elevation. Hummock-and-hollow microtopography, braided streams, areas of coarse gravel and cobble deposition, muck-filled depressions, and abundant *Sphagnum* mats are typical habitat features. Soils are very strongly to extremely acidic, with low base status. Composition is variable over the range of this group, and several community types are probably represented. *Acer rubrum*, *Nyssa sylvatica*, *Liriodendron tulipifera*, and *Pinus rigida* are typical trees, while *Ilex verticillata*, *Rhododendron viscosum*, *Vaccinium corymbosum*, and *Vaccinium fuscatum* are abundant shrubs. *Symplocarpus foetidus* and *Veratrum viride* may be as dominant in these communities as in Montane Basic Seepage Swamps; herbs and low shrubs more abundant in or restricted to acidic swamps include *Osmunda cinnamomea*, *Rubus hispidus*, *Parnassia asarifolia*, *Platanthera ciliaris*, *Lycopodium obscurum*, *Carex debilis*, and *Carex folliculata*. Acid seeps are widely distributed across the forest. Most are very small in size and often consist of a seasonal spring that may stop flowing during the summer, but with soil moist enough to support such plant species as cinnamon fern, royal fern, rushes, sedges, and sphagnum moss. These seeps are often linear following a drainage and may be up to several meters wide and many meters long. Other seeps are larger in size and located in flatter areas and have a more constant source of water.

Example:

- Seepage marsh/wet meadow-Indian Grave Gap, Clinch

BEAVER MEADOWS

Beaver ponds and associated wetlands are scattered across the Forest. Beavers are becoming more numerous and these types of wetlands should increase in number. Beaver created wetlands are important breeding sites for odonates as well as generally being an important wetland element in the landscape. The main limiting factor may be conflicts between beaver impoundments and human interests.

Example:

- Glady Fork beaver meadow, Clinch

ROCKY BARS AND SHORES

These communities are characterized by seasonally flooded to intermittently exposed shrub and herbaceous vegetation of rock outcrops and boulder or cobble bars on the shores and islands of large, high-gradient streams. Communities in this group are scattered throughout the Virginia mountains and Piedmont, primarily along major rivers and their larger tributaries. Habitats are influenced by a frequent regime of powerful flood-scouring, and soils consist of fine to coarse alluvial materials deposited among outcrops and boulders. Vegetation varies from densely shrubby to entirely herbaceous and sparse. Woody scrub, including battered *Platanus occidentalis*, *Betula nigra*, *Salix caroliniana*, *Salix nigra*, *Salix sericea*, *Salix eriocephala*, *Cornus amomum*, *Cornus obliqua*, *Cephalanthus occidentalis*, and *Viburnum* spp., is relatively common on stable bars and outcrops. Herbaceous composition is highly variable and includes species common to ephemeral sand, gravel and mud bars (*e.g.*, *Justicia americana*) and more stable bedrock habitats (*e.g.*, *Andropogon gerardii*). A well-marked herbaceous variant of this group, known from bouldery banks and bars along a number of mountain streams, is dominated by *Carex torta*. Substantial data on the composition and environmental dynamics of rocky bar and shore communities in Virginia has yet to be collected. Examples of this type are very limited on the Forest because large, high gradient streams are not common.

Example:

- Rocky Bar and Shore-Chimney Cliffs Russell Fork, Clinch

RIVERSIDE PRAIRIES

The communities include temporarily flooded, sparse shrub and dense grassland vegetation of stabilized outcrop or boulder bars along the shores of major mountain and Piedmont rivers. Communities in this group are globally and state-rare. In Virginia, most of the few known occurrences are located in the Potomac River gorge west of Washington, D. C. and along the James River near the Blue Ridge. Habitats supporting Riverside Prairies are elevated above mean water levels and are flooded-scoured at least once annually. Because of rockiness and limited alluvial deposition, soils are relatively shallow and site moisture conditions range from mesic to somewhat xeric. The vegetation is a lush assemblage of warm-season grasses and forbs; with scattered woody scrub such as stunted *Fraxinus pennsylvanica*, *Cornus amomum, Cornus obliqua*, and *Salix* spp. Dominant grasses are usually *Andropogon gerardii*, *Sorghastrum nutans*, and *Panicum virgatum*. Other characteristic plants include *Baptisia australis*, *Spartina pectinata*, *Orbexilum pedunculatum* var. *psoralioides*, *Physostegia virginiana*, *Lespedeza violacea*, *Silphium trifoliatum*, *Veronicastrum virginicum*, *Helianthus occidentalis*, *Vicia americana*, *Pycnanthemum tenuifolium*, *Eleocharis compressa*, *Lathyrus venosus*, and *Zizia aurea*. Riverside prairies are found along major rivers which are very limited on the Forest.

Examples:

- Riverside prairie-James Riverside Prairie, Glenwood
- Riverside prairie (4)– James River Gorge Rare Community Assemblage, Glenwood
- Wetland rare communities support a large number of species of viability concern (Appendix E).

Direct and Indirect Effects

Wetland rare communities would be managed under all alternatives under the 9F Rare Community Management Prescription for protection, maintenance, and, where possible, restoration. These wetlands generally fall within riparian corridors, so provisions of the Riparian Prescription also would apply. Standards under all alternatives provide for protection of hydrologic function of wetland rare communities, and prohibit fish stocking to maintain suitability for amphibian breeding. Beaver created wetlands would normally be treated as rare communities, but beaver populations and impoundments could be managed to avoid adverse impacts to public safety, facilities, private land resources, at-risk species, and other rare communities.

Because wetland rare communities would be protected and maintained in all alternatives, no adverse direct or indirect effects to these communities are expected. Restoration efforts and creation of new wetlands through beaver activity may result in increased occurrence of these communities to the benefit of associated species. However, analysis indicates that, under all alternatives, wetland rare communities would remain uncommon on the forest because of their naturally limited distribution.

Cumulative Effects

Because all alternatives place priority on protection and maintenance of these communities, cumulative effects on national forest system lands are expected to be positive. However a significant proportion of Southern Appalachian wetland rare communities are located on private lands (SAMAB 1996: 190) where protection may be poorly regulated. For these reasons, protection of these habitats on national forest land is important to maintaining viability of associated species within the region.

HIGH ELEVATION BALDS AND ROCKY SUMMITS

These communities are of two types: grassy balds and shrub (or heath) balds. Grassy balds are characterized by extensive areas dominated by herbaceous vegetation at high elevations (generally above 5,000 feet). They generally are found on ridgetops, domes, and gentle slopes. Shrub balds are typically found on steep exposed slopes and ridges at elevations ranging from 2,000 to 6,500 feet, and are characterized by dominance of ericaceous shrubs. These communities are found in the Appalachian region. Primary management needs are protection from recreational impacts and maintenance of desired vegetation using a variety of methods. This community includes Grassy Balds and Heath Balds as defined in the Southern Appalachian Assessment (SAMAB 1996: 181-182), and all Associations within the following Ecological Groups as defined by NatureServe (2001a):

436-10 Appalachian Highlands Grassy Balds

436-20 Appalachian Highlands Shrub Balds

Some environmental factors that occurred historically on heath balds include high precipitation, extreme cold, frequent fog and wind. Conditions typically occurring on grassy balds include strong wind, high rainfall, frequent fog and extremes of temperature and moisture. Species composition varies regarding topographic features, moisture, exposure, types of disturbances and land use history. Oat grass tends to dominate the drier sites, while sedge tends to dominate the moist sites. One of the more distinctive characteristics of a grassy bald in relation to other high elevation communities is that it has extensive ranges dominated by herbaceous vegetation. (SAMAB 1996: 181-182)

The known distribution of rare grassy and heath bald communities is described in the Southern Appalachian Assessment Terrestrial Technical Report (SAMAB 1996:188-190). This report indicates that approximately two-thirds of the occurrences of grassy balds and nearly one half of the occurrences of heath balds in the southern Appalachian area are located on national forest system lands.

Many species of viability concern are associated with grassy and shrub bald communities (Appendix E).

There are four balds currently recognized on the Jefferson National Forest as shown in Table 3-34 along with their approximate acreage. Each of these is recognized as grass balds primarily, although relatively small areas of heath bald and high elevation rocky summits exist at Whitetop Mountain and within the Crest Zone balds. The heath balds and high elevation rocky summits within the Crest Zone are located predominately along Wilburn Ridge. These areas are very important to a variety of rare plants and animals. The primary threat to grassy bald habitat appears to be the increasing encroachment of woody stems such as hawthorne, red spruce, and various northern hardwood species. The primary threat to high elevation rocky summits is overuse by forest visitors for rock climbing and repelling which may damage the flora and fauna of these areas.

Table 3-34. Existing bald habitats on the Jefferson National Forest and their approximate acreage

Bald Name	Acres	Ecological Section
Whitetop Bald	155	Blue Ridge
Elk Garden	80	Blue Ridge
Crest Zone	2,200	Blue Ridge
Chestnut Ridge	85	Ridge & Valley

The Jefferson National Forest plan objectives outlines restoration of historic communities, and maintenance of balds using such tools as hand cutting, grazing, prescribed burning, mechanical treatments, and herbicides. The Crest Zone bald will be managed under the 4K3 Special Area Management Prescription and Whitetop and Elk Garden balds will be managed under the 4K4 Special Area Management Prescription. Chestnut Ridge will be managed under the 4A Appalachian Trail Management Prescription.

Direct and Indirect Effects

Balds are considered a rare community and would be managed, restored, and protected under all alternatives with the exception of Alternatives B and G. Debate exists whether these areas are natural occurrences or remnants of early logging and grazing. Eliminating the management activities designed to maintain these rare communities may restore and increase the area of the Spruce-fir rare community as well as the northern hardwood forest community both of which are important to the federally listed Northern flying squirrel. Alternative G would cease all maintenance and restoration activities on grassy and shrub balds, allowing them to succeed naturally to spruce-fir or northern hardwood forest communities. Alternative B would continue to maintain only the core areas of the Crest Zone and Whitetop grassy balds and all of the shrub balds. No restoration activities would occur under Alternative B.

Table 3-36. Current acres of balds and expected acres for each alternative

Alternative	Acres
Current	2,520
A	2,520
B	347
D	2,505
E	2,520
F	2,520
G	0
I	2,376

Restoration and maintenance of balds would benefit these communities under Alternatives A, D, E, F, and I; however, they will remain rare and poorly distributed on National Forest System lands due to their naturally limited distribution and constraints on the ability to manage as described above. See Table 3-35 for projected rates of bald maintenance and restoration.

Alternatives D and I provide for slight decreases in the current acres of balds on the Mount Rogers NRA as shown in Table 3-36. The acreage reduction will allow for red spruce restoration through both plantings and natural reforestation of selected sites. This will provide corridors between presently isolated patches of occupied and unoccupied habitat used by Northern flying squirrels, Weller's salamander and other species of special concern.

Table 3-35. Expected Activity Levels related to the maintenance and restoration of balds for the Jefferson National Forest by Alternative

Activity	Alternative						
	A	B	D	E	F	G	I
Average annual acres of balds to be restored	46	0	46	46	46	0	36
Average annual acres of balds to be burned, mechanically treated etc. for maintenance	892	104	856	892	892	0	802

Cumulative Effects

On the Jefferson National Forest grassy and shrub balds are few in number, patchy in distribution and are located in primarily on the Mount Rogers National Recreation Area. The limited number of recognized balds in Virginia all occur on national forest system lands and, therefore, the perpetuation of this community is contingent on management activities on national forest system lands.

CAROLINA HEMLOCK FORESTS

Carolina Hemlock Forests are dominated or co-dominated by Carolina hemlock (*Tsuga caroliniana*). These forests have a restricted range that mirrors the patchy distribution of Carolina hemlock, which is a Southern Appalachian endemic, occurring primarily in the Central and Southern Blue Ridge Province from Virginia south to northeastern Georgia and northwestern South Carolina with scattered occurrences in the western Piedmont and Ridge and Valley. In Virginia these forests occupy a few small, local, scattered sites on dry to xeric mountain slopes and rocky bluffs of the Blue Ridge and Ridge and Valley south of the James River. Sites are typically very steep and rocky, with shallow, nutrient-poor soils. Common associates are chestnut oak (*Quercus prinus)*, white oak (*Quercus alba)*, scarlet oak (*Quercus coccinea)*, pine species (*Pinus* spp), black gum (*Nyssa sylvatica)*, and various ericaceous shrubs like mountain laurel (*Kalmia latifolia*) and Catawba rhododendron (*Rhododendron catawbiense*). Stand structure (physiognomy) varies from closed-canopy to very open, approaching a woodland structure. These communities often occur in patch-mosaics with fire-influenced oak/heath and pine-oak/heath vegetation. Fire may be an important factor that has limited Carolina hemlock, evidently a fire-intolerant species, to rocky areas and bluffs that are somewhat protected from burning. Currently, the non-native invasive insect pest, hemlock woolly adelgid (*Adelges tsugae*) poses a major threat to the viability and continued existence of Carolina hemlock (as well as Eastern hemlock (*Tsuga canadensis*)). Community types in this group are generally considered globally rare (Fleming and Coulling, 2001).

Over the full geographic range of this forest community, stands typically occur on narrow ridges and upper, north-facing rocky slopes. Four documented Virginia stands occurred at elevations from 1,940 feet to 3,525 feet. Sites include a narrow spur ridge crest, one upper slope, and two middle slopes, with south, southwest, and north aspects. Slopes are strongly convex. Two sites have substantial surface cover of rocks (70% and 31%), while the other two sites have negligible rock cover. Soils are extremely acidic (mean pH = 3.8), with very low calcium and magnesium levels and high iron and aluminum levels (Fleming and Coulling, 2001).

These rare forests are separated into three distinct subtypes that are included in one ecological group (401-20) as defined by NatureServe 2001:

- Carolina Hemlock / Mountain Laurel-Catawba Rhododendron Forest (typic type)
- Carolina Hemlock-(Pitch Pine, Table Mountain Pine, Virginia Pine) Forest (pine type)
- Carolina Hemlock-(Eastern Hemlock) / Great Rhododendron Forest (mesic type)

The typical expression of the type has a canopy dominated by *Tsuga caroliniana*, with minor associates of *Quercus prinus*, *Pinus virginiana*, *Pinus pungens*, *Pinus rigida*, *Nyssa sylvatica*, and *Quercus coccinea*. The shrub layer tends to be dense and dominated by ericaceous species, particularly *Kalmia latifolia*, *Rhododendron catawbiense*, *Rhododendron minus*, and *Leucothoe recurva*. Herbs are sparse but can include species such as *Xerophyllum asphodeloides* and *Polypodium appalachianum*.

Occurrences in Virginia are strongly dominated by *Tsuga caroliniana*, with *Quercus prinus* the most important canopy associate. *Quercus rubra*, *Quercus alba*, several *Pinus* spp., *Nyssa sylvatica*, and *Acer rubrum* are minor canopy associates. *Acer rubrum*, *Amelanchier arborea*, and *Sassafras albidum* are common understory trees, while *Rhododendron catawbiense*, *Kalmia latifolia*, and *Hamamelis virginiana* are dominant shrubs. Additional shrubs include *Pieris floribunda*, *Vaccinium pallidum*, *Rhododendron periclymenoides*, and *Gaylussacia baccata*. The herb layer is generally sparse with scattered individuals or patches of *Aralia nudicaulis*, *Carex pensylvanica*, *Chimaphila maculata*, *Cunila* *origanoides*, and *Hexastylis virginica*. Species richness ranges from 12 to 19 taxa per 400 m^2 (mean = 16).

Although no doubt a rare, small-patch community type in Virginia, additional examples are likely on the Forest and should be sought. The long-term impact of hemlock woolly adelgid on Carolina hemlock needs systematic study. The role of fires in the ecology of Carolina Hemlock Forests is also unclear, since evidence of stand expansion both following fires and periods of fire exclusion have been noted (Schafale and Weakley 1990). Rentch *et al.* (2000) found that Carolina hemlock dominating a site in Bottom Creek Gorge (Montgomery County, Virginia) was long-lived, very tolerant of drought stresses, and had reproduced episodically over the past 200 years. No evidence of fire is mentioned in this paper. Further description of the life history of Carolina hemlock can be found in Humphry (1989).

In addition to Carolina hemlock, another rare plant species of concern that is associated with Carolina Hemlock Forests on the Jefferson National Forests is piratebush (*Buckleya distichophylla*). (Appendix E)

The known distribution of Carolina Hemlock Forests across the southern Appalachians includes five occurrences on National Forests, one occurrence in National Parks, and six occurrences under private ownership (SAMAB 1996).

Representative sites in the Jefferson National Forest include:

- James River Face Wilderness, near Marble Spring, Glenwood
- Raven Cliff Recreation Area, SW slope of Gleaves Knob, NRA

Direct and Indirect Effects

Carolina Hemlock Forests are considered a rare community and are afforded protection in all Plan alternatives through the 9F (Rare Community) management prescription. Through the rare community management prescription, Carolina Hemlock Forests will be managed for protection, restoration, and/or maintenance. Because restoration and maintenance methods are not well defined at this point, management strategies are primarily aimed at protection of existing sites. Despite these protections, this community will remain rare and poorly distributed on National Forest System lands due to its naturally limited distribution. The current amount and distribution of Carolina Hemlock Forests is threatened throughout its range by the recent emergence of the hemlock woolly adelgid in the southern Appalachians. First identified in the eastern United States near Richmond, VA in 1924, this non-native invasive pest has recently spread into the southern Appalachians and threatens to spread throughout the range, causing mortality within five years after initial infestation (SAMAB 1996).

Cumulative Effects

The fact that these communities are spatially small in acreage and most occurrences are on private land leaves this rare community type vulnerable throughout its range. This limited distribution coupled with the immediate threat of mortality from the hemlock woolly adelgid, which will impact the species regardless of land ownership, leaves the long-term persistence of this community type in question. It is very likely that Carolina Hemlock Forests will persist in slowly dwindling numbers where it now occurs for the next ten years but will be eliminated from the landscape as a naturally occurring species and community type in 50 years.

BEECH GAP FORESTS

Beech Gap Forests are characterized by an overstory canopy dominated with American beech (*Fagus grandifolia*) on slopes and near mountain gaps above 4,000 feet. Virginia examples of the type occur at elevations from 3,600 to 5,200 feet. Mean elevation of 28 plot-sampled Virginia stands is 4,400 ft. Habitats include a wide range of slope positions and aspects. Surface cover of bedrock and boulders is typically less than 25%, but occasionally higher. Soil samples collected from plot-sampling sites are consistently extremely acidic (mean pH = 3.8) with low base status. Beech gap forests are considered a distinctive subtype of the northern hardwood forest (Schafale and Weakley 1990). These forests have a very restricted range and typically occur as small acreages. As a result of exposure to severe climatic conditions (wind, snow, ice), the canopy trees typically have a distinctive stunted and gnarled appearance. Shrub layers are typically sparse and herbaceous growth dense. This community is found in the Southern Appalachians and is endemic to the higher elevations of the Southern Blue Ridge in eastern Tennessee, western North Carolina, and southwestern Virginia. In the Virginia Blue Ridge, it is prevalent in the Mount Rogers-Whitetop Mountain area and at high elevations of the Iron Mountains (Fleming and Coulling, 2001). This community corresponds to Beech Gap Forest as defined in the Southern Appalachian Assessment (SAMAB 1996:179), and the following Associations defined by NatureServe (2001a, 2001b):

CEGL006246 Southern Appalachian Beech Gap (North Slope Tall Herb Type)

CEGL006130 Southern Appalachian Beech Gap (South Slope Sedge Type)

Beech Gap Forests are localized and found only on the Blue Ridge. These forests are typically found on convex, often south-facing slopes and ridge spurs with very infertile soils. *Fagus grandifolia* is the clear (sometimes overwhelming) canopy dominant, although yellow birch (*Betula alleghaniensis)* and sugar maple (*Acer saccharum)* are constant, less abundant canopy associates. Yellow buckeye (*Aesculus flava)* is essentially absent from this unit, while Fraser magnolia (*Magnolia fraseri)*, Eastern hemlock (*Tsuga canadensis)*, and red spruce (*Picea rubens)* are locally important canopy associates. Understory and shrub layers are dominated by young *Fagus* and *Acer saccharum*, in addition to striped maple (*Acer pensylvanicum)* and red maple (*Acer rubrum)*. This subtype often has a well-developed shrub layer with hobblebush (*Viburnum lantanoides)* dominant. Herb layers are moderately sparse to moderately dense and graminoid-rich; large patches of Northern woodland sedge (*Carex lucorum* var. *austrolucorum)* are particularly characteristic. Other frequent or abundant herbs are round-leaf violet (*Viola rotundifolia)*, fancy fern (*Dryopteris intermedia)*, Blue Ridge white heart-leaf aster (*Eurybia chlorolepis (= Aster chlorolepis))*, whorled aster (*Oclemena acuminata* (= *Aster acuminatu*)), shining clubmoss (*Huperzia lucidula)*, white wood-sorrel (*Oxalis montana)*, New York fern (*Thelypteris noveboracensis)*, hayscented fern (*Dennstaedtia punctilobula)*, sedge (*Carex aestivalis)*, sedge (*Carex debilis* var. *rudgei)*, and Northern shorthusk (*Brachyelytrum septentrionale)*. Mean species richness of plot-sampled stands is 37 taxa per ~0.1 acre (400 $m^{2)}$.

Most of the range of this forest is on public lands administered by the U.S. Forest Service (Pisgah, Nantahala, Cherokee, and Jefferson National Forests) and National Park Service (Great Smoky Mountains National Park and Blue Ridge Parkway) (SAMAB 1996: 190). There are less than ten occurrences of Beech Gap Forests in Virginia. Most are on the Jefferson National Forest in the Mount Rogers area.

Examples of these occurrences are:

- Mount Rogers National Recreation Area-Whitetop Mountain (prevalent)
- Mount Rogers National Recreation Area-Beech Mountain (prevalent)
- Mount Rogers National Recreation Area-Mount Rogers & Elk Ridge (prevalent)
- Mount Rogers National Recreation Area-Pine Mountain (prevalent)
- Mount Rogers National Recreation Area-Iron Mountains / Roundtop (local, north slopes at high elevations)

Direct and Indirect Effects

Beech Gap Forests would be managed under the 9F Management Prescription under all alternatives. Because site-dependent factors such as elevation, aspect, and soils have shaped existing Beech Gap Forests, opportunities for increasing their extent are limited. Maintenance of existing sites would focus on protection from recreational impacts and management implemented disturbances. Despite these protections, this community will remain rare and poorly distributed on Forest lands due to its naturally limited distribution. However, non-native invasive plants such as garlic mustard (*Alliaria petiolata*) and animals such as wild boars and gypsy moth may represent future threats on the Jefferson. Currently the greatest threat to Beech Gap Forests is from a disease complex commonly called beech bark disease. This disease complex is composed of a beech scale insect and a fungus. The scale insect and at least one of the fungus types are non-native. The beech scale was introduced to North America through Nova Scotia, Canada in the late 1800's and is now a common pest of American beech throughout the tree's range. The beech scale attacks beech bark creating wounds that are subsequently colonized by the fungus *Nectria coccinea var. faginata* (non-native) or *N. galligena* (native). The fungi cause cankers that eventually coalesce to girdle the host tree and lead to its death. The disease complex was first identified in the Southern Appalachians in the early 1990's. The disease continues to spread across a broad front as it moves south. In the early phase of the disease cycle more than 50% of the beech trees larger than 10" dbh are killed. These openings in the forest canopy then result in a dense stand of root-sprouts which in turn yield stands dense with beech and deficient in other normally associated vegetation. In the next phase of the disease cycle revegetated beech forests are attacked less severely resulting in diseased survivors rather than extensive mortality. Trees in this phase are rarely girdled but are generally severely deformed (Ward and Mistretta, 2002). The eventual result is a forest with altered size and structure and a less species-rich understory due to the prolific growth of beech sprouts.

Cumulative Effects

Damage to Southern Appalachian American beech dominated forests has only just begun. Explosive buildups of beech scale insect populations have not yet occurred in many places where the insects are known to be present (Ward and Mistretta, 2002). Regardless of ownership and any protections or designations provided, Beech Gap Forests will therefore remain rare and decrease in quality and acreage across the Forest under all alternatives due to the beech bark disease complex.

BASIC MESIC FORESTS

These communities are typically characterized by closed-canopy deciduous overstories and rich and diverse understories of calciphilic herbs, underlain by high-base geologic substrates with moist soil conditions. On moderate to high elevation sites, these communities are typically found in protected coves, and can be distinguished from more acidic mesic cove forests by the abundance of species such as white basswood (*Tilia americana*), yellow buckeye (*Aesculus flava*), black walnut (*Juglans nigra*), faded trillium

(*Trillium discolor*), sweet white trillium (*Trillium simile*), black cohosh (*Cimicifuga racemosa*), blue cohosh (*Caulophyllum thalictroides*), whorled horsebalm (*Collinsonia verticillata*), mock orange (*Philadelphus inodorus*), sweet shrub (*Calycanthus floridus*), sweet cicely (*Ozmorhiza* spp.), doll's eyes (*Actaea racemosa*), maidenhair fern (*Adiantum pedatum*), and plantain-leaved sedge (*Carex plantaginea*). Good examples of moderate and high elevation basic mesic forests have a low incidence of white pine (*Pinus strobus*), eastern hemlock (*Tsuga canadensis*), rhododendron (*Rhododendron* spp.), and Christmas fern (*Polystichum acrostichoides*) since these species are found in more acidic soil conditions.

On lower elevation sites, these communities are more typically found on north slopes, where dominant and characteristic overstory species are American beech (*Fagus grandifolia*) and northern red oak (*Quercus rubra*), with tulip poplar (*Liriodendron tulipifera*), white oak (*Quercus alba*), shagbark hickory (*Carya ovata*), or white ash (Fraxinus *americana*), with southern sugar maple, chalk maple, painted buckeye (*Aesculus sylvatica*), and pawpaw (*Asimina triloba*) in the midstory and shrub layers, and understories that include faded trillium, nodding trillium(*Trillium rugelii*), black cohosh, doll's eyes, foam flower (*Tiarella cordifolia var. collina*), bloodroot (*Sanguinaria canadensis*), bellworts (*Uvularia sp.*) and trout lilies (*Erythronium spp.)*. Good examples of low elevation basic mesic forests have a low incidence of sweetgum (*Liquidambar styraciflua*), loblolly pine (*Pinus taeda*), and non-native invasives such as Japanese honeysuckle (*Lonicera japonica*) or Chinese privet (*Lingustrum vulgare*).

Basic mesic forest communities are found in both the Appalachian and Piedmont regions. This community includes the following Associations defined by NatureServe (2001a, 2001b):

CEGL007711 Southern Appalachian Cove Forest (Rich Foothills Type)

CEGL007695 Southern Appalachian Cove Forest (Rich Montane Type)

CEGL008488 Southern Ridge and Valley Basic Mesic Hardwood Forest

For the Jefferson National Forest the basic mesic rare community type is composed of two ecological communities as defined by the Virginia Division of Natural Heritage (Fleming and Coulling 2001): 1) Rich Coves and Slope Forests, including the Central Appalachian Rich Cove Forest (sugar maple-basswood type) and Southern Appalachian Rich Cove Forest (typic type), but not the Central Appalachian Rich Cove Forest (tuliptree-northern red oak-cucumbertree type); and 2) Basic Mesic Forests. These ecological communities are described as follows:

RICH COVE AND SLOPE FORESTS

These include mixed hardwood forests of fertile, mesic, mountain-slope habitats at elevations ranging from about 1,000 feet to about 3,600 feet. Distributed locally throughout western Virginia, these forests are strongly associated with moist, sheltered, landforms (*i.e.*, coves, ravines, and concave lower slopes). Soils may be weathered from various substrates and generally range from strongly acidic to moderately alkaline, with high base saturation. In these habitats, soil fertility appears to be strongly correlated with high base cation levels (particularly calcium, magnesium, and manganese) rather than with high pH, and higher-elevation sites often have soils with surprisingly low pH. Characteristic trees include *Acer saccharum*, *Tilia americana* var. *americana* and var. *heterophylla*, *Fraxinus americana*, *Liriodendron tulipifera*, and *Aesculus flava*. Herbaceous growth is lush with spring ephemerals and leafy, shade-tolerant forbs such as

Caulophyllum thalictroides, *Impatiens pallida*, *Trillium grandiflorum*, *Laportea canadensis*, and many others. Compositional variation related to substrate and elevation is complex and will require intensive future study. The principal threats to rich cove forests are logging and invasion by *Alliaria petiolata* and other shade-tolerant, non-native invasive weeds.

Examples:

- Central Appalachian rich cove forest (sugar maple-basswood type) -Rich cove/ mesic slope forest-Lovelady Coves, Clinch
- Central Appalachian rich cove forest (sugar maple-basswood type) - Rich cove/ mesic slope forest (4)-Cliff Mt., Clinch
- Central Appalachian rich cove forest (sugar maple-basswood type) - Rich cove/ mesic slope forest-Lower Little Stony Creek, Clinch
- Central Appalachian rich cove forest (sugar maple-basswood type) - Rich cove/ mesic slope forest (2)-Staunton Creek Gorge, Clinch
- Central Appalachian rich cove forest (sugar maple-basswood type) - Rich cove/ mesic slope forest-Whitetop Mtn., Mount Rogers National Recreation Area
- Central Appalachian rich cove forest (sugar maple-basswood type)-Apple Orchard Falls, Apple Orchard Mtn., Glenwood
- Southern Appalachian rich cove forest (typic type)-Raven Cliff Horse Camp, Mount Rogers National Recreation Area

BASIC MESIC FORESTS

These include mixed hardwood forests of fertile, mesic, low-elevation habitats in the Coastal Plain, Piedmont and lower slopes and valleys of the mountain region. Typical sites are deep ravines, sheltered north- or east-facing slopes subtending large streams and rivers, and occasionally well-drained floodplain terraces. Soils are usually weathered from carbonate or mafic bedrock, or from calcareous, shell-rich deposits in the Coastal Plain. Dominant trees include the species of Rich Cove and Slope Forests, as well as *Quercus muehlenbergii*, *Acer nigrum*, *Acer barbatum* (Coastal Plain and Piedmont only), *Fagus grandifolia*, *Carya cordiformis*, and *Juglans nigra*. Shrub and herb layers contain a number of species that are atypical of mountain slopes, such as *Asimina triloba*, *Jeffersonia diphylla*, *Erigenia bulbosa*, and *Trillium sessile*. The extent and viability of basic mesic forests have been reduced by repeated logging and invasive non-native invasive weeds.

Example:

- Central Appalachian/piedmont rich slope forest (twinleaf-canada waterleaf type)-Smith Tract (lower slope along James River), Glenwood

The Southern Appalachian Assessment (SAMAB 1996:49) combined mesic and xeric mafic communities, and concluded that only 25% of the known occurrences for species associated with mafic and other calcareous habitats, occurred on National Forest land. Several species of viability concern are associated with basic mesic forests, with the majority being vascular plants (Appendix E).

Direct and Indirect Effects

All high quality basic mesic forest communities will be managed under the 9F (Rare Community) management prescription under all alternatives. Primary management needs are protection from undesirable disturbance. These communities are characterized by low intensity, low frequency disturbances, and are often most threatened by recreational use, since many are desirable for interpretive trails. Several standards for rare communities ensure their maintenance or restoration across the Forest. The 9F management prescription encourages the exclusion of basic mesic forests from prescribed burning blocks where this can be accomplished without large increases in fireline construction, and discourages direct firing unless necessary to secure control lines. Only low intensity fires are allowed. Alternative E, which emphasizes recreation, may present the greatest management challenge to protection of these communities and associated species. Additional rare communities standards are designed to reduce or eliminate adverse effects to rare communities caused by recreational use.

Since rare communities would be protected or restored across all alternatives, the effects of National Forest management on these communities and associated species would be positive under all alternatives. However, under all alternatives this community will remain relatively rare on the forest because of its naturally limited distribution.

Cumulative Effects

The cumulative effect on the quantity and distribution of basic mesic forests is determined by considering trends in the status of these communities through time and across private and public ownerships. Even though people increasingly use the National Forest for recreational or social needs, protection actions will have positive effects. However, based on regional conditions reported in SAMAB (1996:49), the Jefferson National Forest likely contains a relatively small proportion of known occurrences of this community type. Examples of the type on private lands are unlikely to receive the same level of protection. It is expected that the cumulative effects of development, recreational use, timber harvest, and other activities on private lands will result in a decrease of good examples of these community types across the landscape, making National Forest examples increasingly valuable to regional conservation.

ROCK OUTCROPS AND CLIFFS

Rock outcrops and cliffs are defined here as rare communities and include the following types of communities as defined in the Southern Appalachian Assessment (SAMAB 1996:179-186), and by NatureServe (2001). Regional descriptions are given followed by the relevant ecological communities for the Jefferson National Forest from Fleming and Coulling (2001), and Fleming, et al. (2001).

TALUS SLOPES

Regional Description. This community is characterized by nonvegetated or sparsely vegetated accumulations of rock at 2,500 to 4,600 feet elevation. It is found in the Appalachian region and is distinguished from Forested Boulderfields by the lack of trees, and from rocky summits by its occurrence on side slopes as opposed to ridges and peaks. This community includes Talus Slopes as defined in the Southern Appalachian Assessment (SAMAB 1996:186), and all Associations within the following Ecological Group as defined by NatureServe (2001):

430-10 Eastern Acid Talus

MOSS / LICHEN BOULDERFIELDS

These communities consist of non-vascular vegetation occupying exposed, minimally weathered boulderfields on mountain ridges of western Virginia. Boulderfield habitats have resulted from periglacial phenomena and the collapse of resistant strata from weathering and erosion of weaker underlying rocks. The most numerous and extensive exposed boulderfields are composed of sandstone or quartzite, with a few occurrences on metabasalt at higher elevations of the Northern Blue Ridge. These habitats, where few vascular plants survive, are often densely populated by overlooked or cryptic species of lichens and moss. Dominant on boulders are umbilicate "rock tripe" lichens, including *Umbilicaria mamulata, U. muehlenbergii,* and *Lasallia papulosa*. Also common are small, round, tightly attached patches of the bright yellow-green lichen *Dimelaena oreina*. Sheltered surfaces where detritus collects are often colonized by mosses. The most common of these are *Dicranum* spp., but *Hedwigia ciliata* and other species are also present. The fern *Polypodium appalachianum* occurs frequently on weathered edges. Progressive, long-term weathering of exposed boulderfields results in slow invasion by trees such as *Betula alleghaniensis* and *Sorbus americana* at higher elevations, and *Betula lenta* at lower elevations. Open boulderfields are favored by timber rattlesnakes (*Crotalus horridus horridus*), which often locate their hibernacula in the rocky substrates. These small-patch community types are uncommon and are primarily threatened by air pollution and acid rain.

Example:

- Devils Marbleyard-James River Face Wilderness, Glenwood

CLIFFS AND BLUFFS

Regional description. These communities are characterized by steep, rocky, sparsely-vegetated slopes, usually above streams or rivers. Cliff communities may be dry or wet, and include communities associated with waterfalls, such as spray cliffs and rock houses. These communities are found in the Appalachian region. This community includes Calcareous Cliffs, Mafic Cliffs, Sandstone Cliffs, and Spray Cliffs as defined in the Southern Appalachian Assessment (SAMAB 1996:179,182,183,185), and all Associations within the following Ecological Groups as defined by NatureServe (2001a):

430-40 Eastern Dry Acid Cliffs

430-45 Eastern Moist Acid Cliffs

430-50 Eastern Dry Alkaline Cliffs

430-55 Eastern Moist Alkaline Cliffs

430-60 Appalachian Highlands Northern White Cedar Bluffs

430-65 Appalachian Highlands Rock Houses

MOUNTAIN ACIDIC CLIFFS

These cliffs include sparse woodland, shrub, and herbaceous vegetation of very steep to precipitous sandstone, acidic shale, and quartzite outcrops, cliffs, and rocky escarpments. These communities are scattered throughout the mountain and western Piedmont foothill regions of Virginia, but are poorly inventoried and documented at present. Acidic cliffs occur under several geomorphic conditions, especially on slopes undercut by large streams or rivers and on resistant caprock exposed by differential weathering of weaker underlying strata. Habitats vary with aspect and other environmental conditions. Local zones of ephemeral seepage may be present. The vegetation is generally dominated by lichens, with umbilicate "rock tripe" species such as *Umbilicaria* spp. and *Lasalia papulosa* especially prominent. Vascular plants are confined to crevices and humus-covered shelves. On drier, south- to west-facing cliffs, vascular species may be very sparse and consist of stunted pines *(Pinus virginiana, P. pungens*), ericaceous shrubs, and occasional erbaceous lithophytes such as mountain spleenwort *(Asplenium montanum*), silverling

(Paronychia argyrocoma), and wild bleeding heart *(Dicentra eximia*). Sheltered, north- to east-facing cliffs often support more diverse shrub and herbaceous flora. Characteristic species include stunted eastern hemlock *(Tsuga canadensis*), evergreen rhododendrons *(Rhododendron maximum* and *R. catawbiense*), rock polypodies *(Polypodium appalachianum* and *P. virginianum*), Michaux's saxifrage *(Saxifraga michauxii*), rock alumroot *(Heuchera villosa* var. *villosa*), and wavy hairgrass *(Deschampsia flexuosa* var. *flexuosa*). Shaded grottoes and "rock houses" on cliffs of the Cumberland Mountains in southwestern Virginia support colonies of little-leaved alumroot *(Heuchera parviflora* var. *parviflora*) and round-leaved catchfly *(Silene rotundifolia*). There are few threats to acidic cliffs, except for local damage by rock climbers.

Example:

- Montane acidic cliff-Raven Cliff, Mount Rogers National Recreation Area

XERIC CALCAREOUS CLIFFS

These cliffs consist of sparse shrub and herbaceous vegetation of very steep to precipitous, south- to west-facing limestone and dolomitic outcrops, cliffs, and rocky escarpments. In Virginia, communities of this group are confined to carbonate rock districts of the Ridge and Valley province and Cumberland Mountains. Habitats are usually undercut by large streams or rivers and are situated on upper slopes or crests with predominantly convex slope shapes. Microtopography is rugged and complex, with very high cover of exposed bedrock. The surficial rock and associated edaphic stresses limit overall vegetation cover, woody growth, and species richness. Scattered scrub growth of *Juniperus virginiana*, *Quercus muehlenbergii*, *Philadelphus hirsutus*, *Toxicodendron radicans*, and other shrubs is typical. Prevalent among herbaceous species are lithophytes such as *Asplenium resiliens*, *Asplenium ruta-muraria*, *Carex eburnea*, *Draba ramosissima*, *Melica nitens*, *Minuartia michauxii*, *Muhlenbergia cuspidata*, *Pellaea atropurpurea*, *Pellaea glabella*, *Phlox subulata*, and *Symphyotrichum oblongifolium* (= *Aster oblongifolius*). These small-patch communities are generally considered state-rare, but their conservation status needs further investigation. Because of inaccessible locations, stands seem immune from many types of anthropogenic disturbance. Scattered individuals of non-native invasive weeds sometimes find footholds but are largely excluded from cliffs by the hot, xeric, rocky substrates (Fleming 1999).

Example:

- Central Appalachian limestone/dolomite woodland-Cliff Mtn., Clinch

NORTHERN WHITE-CEDAR SLOPE FORESTS

These forests include mixed, largely coniferous forests in which *Thuja occidentalis* is a dominant or co-dominant tree. This is a rare natural community occurring in small, isolated patches from the Ridge and Valley province of western Virginia south to the Eastern Highland Rim, Ridge and Valley, and low Blue Ridge regions of Tennessee. Habitats are on steep, rocky, mesic to submesic slopes that are undercut by streams and have west to north aspects. Underlying bedrock is usually limestone or dolomite, but one Virginia site is underlain by calcareous Silurian sandstone. *Pinus strobus* and/or eastern hemlock *Tsuga canadensis* are the most frequent (often co-dominant) tree associates, with scattered hardwoods also present. Understory and herbaceous layers are variable but generally contain a number of typical calciphiles such as *Berberis canadensis*, *Dirca palustris*, *Galium boreale*, and *Hepatica nobilis* var. *acuta*.

Example:

- Southern Appalachian northern white-cedar slope forest-Dismal Creek, New River Valley

SPRAY CLIFFS

These cliffs are constantly wet rock faces within the spray or splash zone of waterfalls, or sheltered cliffs saturated with permanent seepage. Communities in this group have been well documented in North Carolina, but have not been studied in Virginia. A few examples, scattered over the entire mountain region of the state, are known from qualitative reports. At this time, very little can be said about the ecological dynamics or floristic composition of these occurrences. Based on casual observations, mosses and liverworts are usually the dominant plants, with vascular species more sparsely rooted in crevices and on moss- or humus-covered shelves. Among the more characteristic or abundant vascular plants are brook saxifrage *(Boykinia aconitifolia*), small enchanter's nightshade *(Circaea alpina* ssp. *alpina*), little-leaved alumroot *(Heuchera parviflora* var. *parviflora*), rock clubmoss *(Huperzia porophila*), saxifrages *(Saxifraga caroliniana* and *S. micranthidifolia*), mountain meadowrue *(Thalictrum clavatum*), and various lithophytic ferns. Very few waterfalls in Virginia are large and constant enough to provide requisite conditions for spray cliff communities. Good examples, therefore, should be high priorities for protection. A full understanding of Virginia's spray cliff vegetation and its relationship to similar vegetation further south in the Appalachians will require comprehensive bryophyte inventories.

Example:

- Sandstone seepage cliff - Raven Cliff, Mount Rogers National Recreation Area

ROCK OUTCROPS

Regional description. These communities are characterized by significant areas of exposed, usually smooth, exfoliating granite or related rocks, with scattered vegetation mats and abundant lichens. These communities are found in both the Appalachian and Piedmont regions. This community includes Granitic Dome and Granitic Flatrock as defined in the Southern Appalachian Assessment (SAMAB 1996:180-181), and all Associations within the following Ecological Groups as defined by NatureServe (2001a):

435-10 Appalachian Highlands Granitic Domes

435-20 Appalachian Highlands Grantic Flatrock

These communities are not known to occur outside the Piedmont in Virginia.

ROCKY SUMMITS

Regional description. This community is characterized by sparsely vegetated outcrops of fractured, irregular rock found above 4,000 feet elevation on peaks, ridges, and upper slopes. It is distinguished from rock outcrop communities by its fractured, irregular rock surface, and from talus slopes and cliff communities by its topographic position on or near summits. It differs from forested boulderfields in its general lack of forest cover. This community is found in the Appalachian region. This community includes High Elevation Rocky Summits as defined in the Southern Appalachian Assessment (SAMAB 1996:182), and all Associations within the following Ecological Group as defined by NatureServe

(2001a):

436-30 Appalachian Highlands Rocky Summits

HIGH-ELEVATION OUTCROP BARRENS

These barrens are scrub and herbaceous vegetation of exposed, metamorphic, igneous, and sedimentary outcrops in the Blue Ridge and Ridge and Valley provinces. The lower-elevation limit of these barrens is about 3,000 feet in northern Virginia, increasing to about 4,000 feet in the Southern Blue Ridge. The full range of environmental and compositional variation in this group, especially in the Southern Blue Ridge occurrences, has not been documented. In the Northern Blue Ridge, high-elevation outcrop barrens occupy granitic and metabasaltic outcrops of mostly west- to north-facing upper slopes and summits. Known examples in the Southern Blue Ridge occur on amphibolite (Buffalo Mountain, Floyd Co.) and rhyolite (Mount Rogers area). A few local examples of high-elevation quartzite barrens occur in the northern Ridge and Valley. While bedrock chemistry no doubt exerts some influence on floristics, geologically heterogeneous habitats share similar microclimatic and edaphic stresses. The habitats are wind-blasted and subject to severe winter temperatures and ice, while oligotrophic soils consist of very thin, local veneers of organic matter, gravel, or silt. Vegetation is usually a patchwork of shrub thickets, herbaceous mats, and lithophytic lichens. Characteristic shrubs are *Sorbus americana*, *Photinia melanocarpa* (= *Aronia melanocarpa*), *Prunus pensylvanica*, *Diervilla lonicera*, *Physocarpus opulifolius* (on mafic outcrops), *Kalmia latifolia*, and severely stunted *Betula alleghaniensis*. Typical herbs are *Saxifraga michauxii*, *Solidago simplex* var. *randii*, *Minuartia groenlandica*, *Hylotelephium telephioides* (=*Sedum telephioides*), *Sibbaldiopsis tridentata*, *Deschampsia flexuosa*, and *Polypodium appalachianum*. A number of remarkable, long-range boreal disjuncts, *e.g.*, *Juncus trifidus*, *Huperzia appalachiana*, and *Trisetum spicatum*, are associated with these outcrops. Community types in this group are considered very rare in Virginia and globally. Threats include trampling and destruction of fragile vegetation mats and non-native invasive weeds such as *Poa compressa* and *Rumex acetosella*.

Example:

- High-elevation outcrop barren (black chokeberry igneous/metamorphic type)-Mt. Rogers, NRA

FORESTED BOULDERFIELDS

Regional description. This community is characterized by rock fields, found at 3,500 to 5,300 feet elevation, that support a variable density of trees, typically dominated by yellow birch. It is distinguished from talus slopes by the presence of trees. It is found in the Appalachian region. This community includes Boulderfields as defined in the Southern Appalachian Assessment (SAMAB 1996:179), and the following Associations as defined by NatureServe (2001a, 2001b):

CEGL004982 Southern Appalachian Hardwood Boulderfield Forest (Typic Type)

CEGL006124 Southern Appalachian Boulderfield Forest (Currant and Rockcap Type)

HIGH-ELEVATION BOULDERFIELD FORESTS AND WOODLANDS

These woodlands are open forests and woodlands occupying relatively unweathered boulderfields at elevations above 3,000 feet in both the Blue Ridge and Ridge and Valley provinces. *Betula alleghaniensis*, *Sorbus americana*, and *Acer spicatum* are the typical dominants of boulderfields weathered from granite, metabasalt, quartzite, and sandstone at the highest elevations. These habitats are usually best developed on north-facing slopes. Trees here are typically gnarled and widely spaced because of difficult establishment and repeated damage from wind and ice. Typical shrubs include *Ribes* spp. and *Sambucus racemosa* (= *Sambucus pubens*). The high cover of exposed rock in these habitats tends to limit overall species richness and herbaceous density. Cool microclimates favor the occurrence of many northern and high mountain species. The globally rare and federally listed Shenandoah salamander (*Plethodon shenandoah*) is endemic to three thinly wooded, high-elevation boulderfields on the Northern Blue Ridge.

Examples:

- Southern Appalachian high-elevation boulderfield forest-North slope Pine Mtn., Mount Rogers National Recreation Area
- Southern Appalachian high-elevation boulderfield forest-North slope Mt. Rogers, Mount Rogers National Recreation Area
- Southern Appalachian high-elevation boulderfield forest-North slope Whitetop Mtn., Mount Rogers National Recreation Area

LOW-ELEVATION BOULDERFIELD FORESTS AND WOODLANDS

These woodlands are open forests and woodlands occupying partially weathered boulderfields at elevations below 3,200 feet. These habitats are widely scattered throughout the mountains on steep sideslopes of ridges, often in zones below large outcrops. Stand composition varies greatly with substrate, aspect, and slope position. *Betula lenta* is often the sole invader of large-block sandstone and quartzite boulderfields, forming pure stands of gnarled, spreading trees. Here, *Parthenocissus quinquefolia* is sometimes the only low-growing plant able to become established in the deep interstices between boulders. On somewhat more weathered or less blocky boulderfields, *Quercus prinus* or mixtures of *Quercus prinus*, *Quercus rubra*, *Nyssa sylvatica*, and *Betula lenta*, along with a greater diversity of shrubs and herbs, may prevail. Cool, north-facing, sandstone/quartzite boulderfields frequently support *Tsuga canadensis* and, locally, disjunct populations of *Betula papyrifera* var. *cordifolia*. On base-rich metabasalt and granitic boulderfields of the Northern Blue Ridge, *Tilia americana*, *Fraxinus americana*, and *Quercus rubra* are characteristic trees. Dolomitic or limestone boulderfields support open stands of *Tilia americana* and *Aesculus flava*, with a variety of mosses, *Cystopteris bulbifera*, and other calciphilic herbs forming dense mats on rock surfaces. Communities in this group are uncommon in Virginia; their classification and distributional status need further assessment.

Example:

- Appalachian calcareous boulderfield forest-North slope Staunton Creek Gorge, Clinch

Many species of viability concern are associated with rock outcrop and cliff communities (Appendix E). The known regional distribution of rare rock outcrop and cliff communities is described in the Southern Appalachian Assessment Terrestrial Technical Report (SAMAB 1996:188-190). According to this source, approximately one third of all occurrences of these communities in the southern Appalachian area are located on national forest system lands.

Direct and Indirect Effects

Rock outcrop and cliff communities are considered rare communities and will be managed optimally for protection, restoration, and/or maintenance. This direction is the same under all plan alternatives, thus the effects of National Forest management on these communities and associated species is expected to be positive. A subset of these communities is associated with riparian areas (spray cliffs, waterfalls, etc.), providing them with the additional protection afforded by the riparian prescription under all plan alternatives. Primary management strategies for these communities under all alternatives would be protection from disturbance by management activities and recreational uses; little to no vegetation management for maintenance or restoration is expected. These communities will remain rare and poorly distributed on National Forest System lands however, due to their naturally limited distribution.

Cumulative Effects

Cumulatively, these communities are vulnerable to negative impacts on private lands, making National Forest sites critical to maintain.

CAVES AND MINES

Caves and mines, while drastically different in their origins (natural vs. human-made), share the commonality that each is characterized by openings in the ground that extend for the most part beyond the influence of sunlight and weather, creating habitats buffered from the surface environment. Included and inseparable from caves are karst features including sinkholes and sinking streams that lead to subterranean environments. Surfaces of karstlands are directly linked to subterranean cave water systems and aquifers (Kastning and Kastning 1990). Caves in carbonate rocks are formed by a solution process that dissolves away rock by weak acid carried in groundwater as it seeps and flows through the subsurface rock. The shape and location of entrances, along with the hydrology, configuration, size, elevation, and patterns of airflow influence the types of fauna found within caves and mines (SAMAB 1996: 180). Cave systems contain unique living communities influenced by lack of light, stable and high humidity, generally stable and moderated temperatures, and a limited distribution of nutrients and energy. Underground aquatic systems contain their own community of organisms. Caves may contain a variety of microhabitats including streams, pools, wet stone, and mudflows along with dry rock and mud banks. Cave faunal assemblages vary widely within and between caves depending on microhabitats and history of connectivity between and within cave systems. Many bats are dependant on caves, both seasonally and year-round. Bats select roosts with temperatures appropriate to their metabolic processes (Tuttle and Stevenson 1977). An intermediate, unusable range of temperatures characterizes most caves, and bats use a very small number of caves, compared to the total number of caves.

In the Southern Appalachians, most caves are found in carbonate (limestone and dolomite) valleys of the Ridge and Valley province and the Cumberland Plateau (SAMAB 1996: 180). The Blue Ridge province contains a few fissure caves formed between and under large metamorphic or igneous rock outcroppings, and a very small number of solution caves. In Virginia there are over 3,200 caves making it only one of six states in the country that have over 2,000 caves. On the Jefferson National Forest there are 39 known caves along with associated sinkholes and karstlands. Since most Forest acreage is located on mountain slopes as compared to valley bottoms little acreage is underlain by carbonate bedrock suitable for cave formation. However caves are found on all Ranger Districts with the Clinch having the most (20), followed by the New Castle (8), and the Glenwood has the fewest with one cave.

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RARE COMMUNITIES

CAVES AND MINES

Abandoned mines mimic cave habitats in some respects and have become key year-round resources for bats. In some cases mines harbor bats displaced from natural roosts (such as caves and large hollow trees) by human disturbance (Tuttle and Taylor 1994). Abandoned mines, depending on their size and configuration, provide microclimates (temperature, humidity, and darkness) similar to those of caves. Mines are used for maternity sites, hibernation sites, migratory stopover sites, and temporary night roosts. Some bat species rely heavily on use of mines range wide, and many bat species are believed to hibernate exclusively in old mines (Tuttle and Taylor 1994). Most abandoned mines that may be suitable for use by cave-associated fauna (i. e. bats) are found on the Clinch, New Castle, and Glenwood Ranger Districts with the greatest concentration on the Clinch. Mines on the New Castle and Glenwood are generally associated with past iron ore exploration and production while mines on the Clinch are associated with coal.

Direct and Indirect Effects

Possible direct threats to caves and mines or the species they support are: 1) direct disturbance or vandalism from human visitation or improperly installed gates/closure devices; and 2) management activities that directly or indirectly result in alteration of temperature, humidity, surface water recharge or water quality (SAMAB 1996:90).

Management actions that may result in indirect alteration of temperature, humidity, surface water recharge or water quality within caves or mines include vegetation clearing and management, construction of roads, trails and other recreation developments, and other use of heavy equipment. Standards under all alternatives provide for buffers around caves and associated features (i. e. sinkholes) along with riparian areas to maintain vegetative cover and in turn microclimatic conditions in caves. Caves occupied by federally listed Indiana bats are placed in management prescription 8E4. Other caves are included in management prescription 9F.

Provisions of the Rare Community management prescription (9F) and forest-wide direction apply to all caves and those mines that support cave-associated species and are the same across all alternatives. Direct disturbance from human visitation is regulated by a standard that requires use of proper closure devices for caves and mines supporting species at viability risk. Consistent inclusion of this standard under all alternatives is expected to reduce frequency and degree of human intrusion, providing beneficial effects to associated species.

All caves and those mines suitable for supporting characteristic fauna would be managed optimally for protection under all alternatives. Because of the priority put on protection of this community and associated species, effects of national forest management are expected to be positive under all alternatives. Examples of caves and mines are shown in Table 3-37.

Table 3-37. Example Caves and Mines on the Jefferson National Forest

Caves and Mines Area Name	Acres
Cave Springs Cave	166
Cliff Mountain	1,603
Little Stone Mountain	1,167
Pine Mountain Tunnel	206
Shires Saltpetre Cave	381
Staunton Creek Gorge	353
Stone Mtn/Powell Mtn Cliffs	318

Cumulative Effects

Caves and other karst features are naturally rare with a significant proportion of Virginia caves (>98%) located on private lands where protection is problematic. For these reasons, effects of protection of this community type on national forest land are important within the region.

TABLE MOUNTAIN PINE WOODLANDS

This community is characterized by a dominant or significant component of Table Mountain pine (*Pinus pungens*) in the overstory, often in combination with pitch pine (*Pinus rigida*). This forested community is a species-poor, fire-influenced, mixed woodland of xeric, exposed mountain habitats. Sites are typically located on convex, south to west slopes of steep spur ridges, narrow rocky crests, and cliff tops. Pine–oak/heath woodlands (of which Table Mountain Pine Woodlands are part of) are widespread throughout the Central and Southern Appalachian region. In Virginia, the type ranges through the Blue Ridge and Ridge and Valley provinces with a few outliers in the Piedmont. The Table-Mountain Subtype occurs throughout this range, while the Pitch Pine Subtype is more confined to the northern two-thirds of the state's mountain region. They occur at elevations from below 1,000 feet to more than 4,000 feet on various substrates, but most commonly on acidic, sedimentary and metasedimentary substrates, *e.g.*, sandstone, quartzite, and shale, but the type is most frequent and extensive on sandstone and quartzite. Soils are very infertile, shallow, and droughty. Thick, poorly decomposed duff layers consisting primarily of pine needles, along with dead wood and flammable shrubs, contribute to a strongly fire-prone habitat (Groeschl et al. 1992). The influences of past fires are seen in the even-aged character of overstory trees to numerous pieces of charred wood debris and charcoal in duff layers (Fleming and Coulling, 2001).

Short-statured *Pinus pungens* and *Pinus rigida* are usually dominants forming an open canopy, often with co-dominant *Quercus prinus*. Less important tree associates include *Quercus coccinea*, *Pinus virginiana*, and *Sassafras albidum*. Except in the Piedmont stands, *Quercus ilicifolia* is characteristic (often abundant) in the shrub layer, along with various ericaceous shrubs. Colonial shrubs usually pre-empt available microhabitats for most herbaceous species, but *Pteridium aquilinum* var. *latiusculum* and the spectacular *Xerophyllum asphodeloides* are often competitive enough to achieve significant cover. Periodic fire is an important ecological process that provides opportunities for regeneration of both pines and less competitive herbaceous species, while setting back successional encroachment of potential canopy oaks (especially *Quercus prinus*). On cliffs and other very rocky sites, the vegetation is self-perpetuating due to extreme edaphic conditions. Fire reduction and the insect pest, southern pine beetle (*Dendroctonus frontalis*) are the most serious threats to communities of this group. The state-rare northern pine snake (*Pituophis melanoleucus melanoleucus*) and several rare moths, all bear oak (*Quercus ilicifolia*) feeders, are locally associated with these woodlands (Fleming and Coulling, 2001).

This community corresponds to Table Mountain pine/Pitch Pine Woodlands as defined in the Southern Appalachian Assessment (SAMAB 1996:185-186), and all Associations within the following Ecological Group as defined by NatureServe (2001a):

401-80 Appalachian Highlands Pitch and Table Mountain pine Woodlands.

This community type is closely related to other associations classified in the *Pinus pungens* - (*Pinus rigida*) Woodland Alliance. It is thought to differ in the shrub layer dominance of *Quercus ilicifolia*, a northern species which is absent in similar communities south of Virginia, the presence of several other northern species, and the absence of a number of characteristic Southern Appalachian species such as *Gaylussacia ursina*, *Rhododendron carolinianum*, *Rhododendron minus*, *Leiophyllum buxifolium*, and *Fothergilla major*.

There are significant differences in site conditions associated with the two subtypes of this community. The Table-Mountain Pine Subtype occurs at low to middle elevations (mean of plot-sampled stands = 2,147 feet) and tends to occupy steep (mean slope = 23º) sideslopes with significant rock cover (mean = 14%). The Pitch Pine Subtype occurs at middle to high elevations (mean of plot-sampled stands = 3,225 feet) and tends to occupy moderately steep to sub-level (mean slope = 7º) upper slopes and crests with little rock cover (mean = 1%) and very dense duff. Although strongly fire-prone habitats influence vegetation structure and composition of both subtypes, the Table-Mountain Pine Subtype tends to be more influenced by edaphic stresses because of its frequent association with cliffs and outcrop areas.

Examples of Table Mountain Pine Woodlands are numerous and widespread on the Jefferson National Forest, although most occurrences consist of small acreages on slopes with a southerly aspect surrounded by oak dominated forests. Such areas include James River Face Wilderness, Broad Mountain, Bald Mountain, Peters Mountain, Potts Mountain, Brush Mountain, Walker Mountain, Brushy Mountain, and Pine Mountain.

Direct and Indirect Effects

Fire reduction and the native insect pest, southern pine beetle (*Dendroctonus frontalis*) are the most serious threats to this community. All alternatives would provide some opportunity to manage for Table Mountain Pine Woodlands on the Jefferson National Forest. Alternatives E and F would have the most limited opportunities to manage for Table Mountain pine while Alternative B would provide the highest opportunities to manage for this community. Restoration and maintenance activities would benefit this community, however Table Mountain Pine Woodlands will remain rare and poorly distributed on National Forest System lands due to their naturally limited distribution. Previous studies of Table Mountain pine regeneration following wildland fires suggest that prescribed fires need to be of high intensity to remove the forest canopy and expose mineral soil for successful regeneration (USDA 1965, Zobel 1969, Sanders 1992). Several recent studies suggest that although fire is needed for regeneration of Table Mountain pine stands, the intensity may vary depending on site conditions. Medium-high intensity burns may get desired results (Welch and Waldrop 2001).

Cumulative Effects

This community is widely but locally distributed in the Central Appalachians, forming large patches at some sites. It is apparently secure, although fire suppression and insect pathogens represent ongoing stand-altering disturbances. Primary management needs are maintenance and expansion of existing occurrences; using thinning, wildland fire use, and prescribed fire.

Private lands are the least likely to be actively managed and therefore existing Table Mountain pine stands are expected to decline over time due to hardwood encroachment and lack of regeneration, both the result of fire exclusion. Although limited in acreage, the maintenance and restoration of this community on National Forest System lands remains critical to perpetuate this forest type.

Long-term, widespread fire reduction or suppression is an ongoing problem which may be causing some stands to succeed to closed, mixed oak-pine forest. However, on some sites (*e.g.*, clifftops) occupied by this community, edaphic conditions are so stressful that oaks are marginally competitive, and even long fire-return intervals (*e.g.*, > 25 years) on these sites are sufficient to maintain pine-dominated vegetation. Within the past ten years, much of this vegetation in Virginia has been devastated by infestations of southern pine beetles (*Dendroctonus frontalis*) as pine stands age in the absence of fire. These outbreaks have resulted in extensive mortality of the dominant pines and have, at least temporarily, led to an increase of oak abundance and/or a reduction of stands to shrublands with numerous pine snags. It is therefore likely that overall acreage of Table Mountain Pine Woodlands will continue decrease in both the next 10 and 50 years due to lack of widespread fire and continued outbreaks of pine beetles.

TERRESTRIAL SPECIES AND THEIR HABITATS

INTRODUCTION

This section of the Affected Environment and Environmental Consequences Chapter discusses different aspects of wildlife and habitat elements. The Jefferson National Forest, along with the rest of Virginia, supports some of the greatest diversity of wildlife found in the temperate latitudes of the world.

For the purposes of this discussion, the term "wildlife" refers to terrestrial wild animals, including arthropods and other invertebrates, that occur on the Forest. A complete listing of the vertebrate species (and a few of the invertebrate species) that occur on the Forest is included in Appendix E.

The Forest is inhabited by an unknown number of terrestrial invertebrate species. There has never been a complete inventory of Virginia's native arthropods and it is likely there may never be (Terwilliger 1991), although entomologists estimate that there are between 20,000 and 30,000 in the state. Many species are microscopic, or nearly so, and require highly trained specialists in order to collect and identify them. For many kinds of arthropods, Virginia has no scientists qualified to do this work. About 10,000 species have been authoritatively recorded as occurring in the state. Except for some of the aesthetically interesting (butterflies, moths, dragonflies) or economically important (termites, garden, household, and/or forest pests) groups, most of this number is relatively unknown. Our best chance of protecting and maintaining the rare species among them is to protect and manage the rare and unique habitats in which they often occur.

A total of 78 species of reptiles and amphibians has been recorded from or adjacent to the Forest (Cooper 1978). This is in contrast to a total of 135 species for the state (Mitchell and Reay 1999). The Jefferson's salamander fauna is especially diverse; we have a total of 34 species on the Forest. Because of the Forest's latitudinal position and the great altitudinal variation, a large number of species that usually occur either further north or further south also find habitat in this area. The Mt. Rogers/Whitetop area is the best example of this. One area of approximately 2,000 acres has 20 different species of salamanders living on it. This is the greatest known diversity of salamanders in an area of this size on Earth. In addition to the 34 species of salamanders, the Jefferson has 13 species of frogs and toads, nine species of turtles, 18 species of snakes, and four species of lizards (Cooper 1978).

Birds of the Jefferson, and surrounding similar habitats, number approximately 180 species. This number includes 70 resident (year-round) species, with the remainder being transients that breed here and winter further south. As discussed above, the Jefferson's geographic (north-south) position and the topographic diversity greatly enhance the variety of the area's bird life.

About 60 species of mammals occur on the Jefferson. The best known (both to science and to the general public) are probably the larger game species, such as the white-tail deer and the black bear. There seems to be a direct correlation between a mammal's size and how much we know about it. The habits and habitats of the red and grey fox and the coyote, the felids (the bobcat and the mountain lion, if it still exists) are relatively well understood, as are those of species such as the beaver, skunks, and rabbits. When you get to the small end of the body-size scale, however, (bats, of which we have 10 species; shrews and moles, of which we have 12 species; and mice, of which we have 10 species) the knowledge of population distribution and habitat requirements drops dramatically. Most of these smaller mammals are nocturnal and/or spend much of their time underground.

SUCCESSIONAL FORESTS

Affected Environment

Successional stages of forests are the determining factor for presence, distribution, and abundance of a wide variety of wildlife. Some species depend on early successional forests, some depend on late successional forests, and others depend on a mix of both occurring within the landscape (Franklin 1988, Harris 1984, Hunter et al. 2001, Hunter 1988, Litvaitis 2001). These habitat conditions are also important as wintering and stopover habitats for migrating species (Kilgo 1999, Suthers 2000, Hunter et al. 2001). Therefore, it is important that varying amounts of both types of habitat be provided within national forest landscapes.

This section deals only with successional forest conditions. Permanent openings such as open woodlands, savannas, grasslands, barrens and glades, balds, wildlife openings, old fields, pastures, and rights-of-way are covered elsewhere in this document. Mid- and late successional conditions are covered only generally in this section; more detailed treatment of desired conditions for these successional stages can be found under individual forest community sections.

For analysis purposes, forest succession is divided into four stages: early, sapling/pole, mid, and late (Table 3-38). Early successional forest is defined as regenerating forest of 0 to 10 years of age for all forest community types. It is characterized by dominance of woody growth of regenerating trees and shrubs, often with a significant grass/forb component, and relatively low density or absent overstory. This condition is distinguished from most permanent opening habitats by dominance of relatively dense woody vegetation, as opposed to dominance of grasses and forbs. Such conditions may be created by even-aged and two-aged regeneration cutting, and by natural disturbance events, such as windstorms, severe wildland fire, and some insect or disease outbreaks. Ages defining the remaining successional stages vary slightly by forest community type. Sapling/pole forest is characterized by canopy closure of dense tree regeneration, with tree diameters typically smaller than 10 inches. Mid-successional forest begins to develop stratification of over-, mid-, and understory layers. Late successional forests, usually greater than 80 years old, include old growth conditions. This stage contains the largest trees and often has well-developed canopy layers and scattered openings caused by tree mortality.

Of particular importance as habitat are forest conditions that exist at both extremes of the forest successional continuum-early successional and late successional forests. Appendix E identifies species of viability concern associated with early successional forests, mixed

Table 3-38. Forest age (years) corresponding to successional stages for each forest community type

Forest Community Type	Successional Stage			
	Early	Sapling / Pole	Mid	Late
Northern Hardwood Forest	0-10	11-40	41-80	81+
Conifer-Northern Hardwood Forest	0-10	11-40	41-80	81+
Mixed Mesophytic Forest	0-10	11-40	41-80	81+
River Floodplain and Eastern Riverfront Forest	0-10	11-20	21-60	61+
Dry-Mesic Oak Forest	0-10	11-40	41-80	81+
Dry and Xeric Oak Forest; Woodland and Savanna	0-10	11-40	41-80	81+
Xeric Pine & Pine-oak Forest & Woodland	0-10	11-20	21-60	61+
Dry and Dry-mesic Oak-pine Forest	0-10	11-40	41-80	81+
Montane Spruce-fir Forest	0-10	11-40	41-80	81+

successional forest landscapes, and late successional forests of a variety of forest community types.

Early successional 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. Early successional forests have the shortest lifespan (10 years) of any of the forest successional stages, and are typically in short supply and declining on national forests in the Southern Appalachians (SAMAB 1996:28), and in the eastern United States (Thompson 2001). Early successional forests are also not distributed regularly or randomly across the landscape (Lorimer 2001). These habitats are essential for some birds (ruffed grouse, chestnut-sided warbler, golden-winged warbler, prairie warbler, yellow-breasted chat, blue-winged warbler, Swainson's warbler); key to deer, turkey, and bear in the South; and sought by hunters, berry pickers, crafters, and herb gatherers for the wealth of opportunities they provide (Gobster 2001). Many species commonly associated with late successional forest conditions also use early successional forests periodically, or depend upon it during some portion of their life cycle (Hunter et al. 2001).

The need for seedling/sapling conditions to provide habitat for birds associated with early successional habitats is a current topic of concern. Old fields can provide conditions required by many early seral species, but this habitat type itself is very uncommon on the National Forest. The minimal area that is required by each species varies and is not fully understood. Kirpez and Stauffer (1994) documented local research findings that harvest groups of approximately 0.5 to 2 acres in size provide suitable habitat for such early seral dependent birds as the indigo bunting and rufous-sided towhee. In addition, local U.S. Forest Service bird monitoring efforts have identified the chestnut-sided warbler, an early seral species, inhabiting group harvest areas of less than 1 acre in size. In a discussion of management of early-successional habitats, Thompson and Dessecker (1997) identified group selection areas of less than 0.5 acres as inadequate for a variety of forest songbirds. Thus, there is a group of forest songbirds, such as the prairie and golden-winged warblers, which require disturbance patches that are less than 10 years of age and greater than 2 acres is size. Thus, the early successional forest habitat that will be created in patches greater than 2 acres, will result from even-aged timber harvest.

In addition to structure and patch size, the elevation at which early seral habitats exist

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plays a role in providing habitat for some species. The chestnut-sided warbler typically occurs at higher elevations on the Jefferson National Forest. Thus, provision of seedling/ sapling habitat needs to be considered at both high and lower elevations.

Sapling/pole stages are generally of least value to wildlife because closed canopies limit understory development, and trees are not yet large and old enough to begin producing mast or other wildlife benefits. However, this successional stage does provide value as cover for some species. Mid-successional forests begin to look and function like late successional forests, and provide habitat for many species that use late successional forests. For most of these species however, mid-successional forests provide lower quality habitat than do late successional forests.

The mid- to late- successional class is defined as beginning at age 40 primarily because eastern hardwood stands begin to produce significant amounts of hard mast at about age 40. Hard mast is a very important component for many wildlife species such as bear, squirrel, and turkey. Therefore, the age at which hardwood stands begin to produce adequate amounts of hard mast, especially upland hardwood stands dominated by oak species, is an important stage in stand development. Hard mast production is highly variable between species as well as individuals of the same species. Hard mast production in any given year is dependent upon many factors including climate and weather, insects and disease, stand density, size of trees, stand composition, and stand age. Many of these factors are either beyond control (e.g. weather) or more appropriately considered at site specific levels (e.g. stand density). For the purposes of effects analysis and disclosure at the Forest Plan level, stand age and stand composition are excellent indicators of a stand's hard mast production capability.

The five major oak species (*Quercus alba, Q. prinus, Q. velutina, Q. rubra*, and *Q. coccinea*) all begin hard mast production at ages from 20 to 25 years old. Maximum acorn production is achieved at 40 to 50 years old. *Carya glabra, C. tomentosa*, and *Fagus grandifolia* produce hard mast in quantity at ages of 30 to 40 years. Finally, *Tilia americana* can begin producing adequate amounts of hard mast as early as 15 years old. (Burns and Honkala 1990.) Goodrum and others found that acorn yields tended to be largest in the classes from 40 to 49 years old up to 90 to 99 years old, but declined thereafter (Goodrum et al. 1971). Shaw arrived at a similar conclusion when he found that stands in his study area ranging from 40 to 80 years old comprised 50% of the management unit, but produced 90 percent of the acorn crop. (Shaw 1971.) Thus, the age of 40 years old as the beginning of significant hard mast production in eastern hardwood forests is widely accepted.

Like early successional forests, late successional forests provide habitats and food supplies for a suite of habitat specialists as well as habitat generalists. These habitats are important providers of high canopy nesting, roosting, and foraging habitat, suitable tree diameters for cavity development and excavation, and relatively large volumes of seed and hard mast. Although it takes many decades for late successional forest conditions to develop, these habitats are more common and contiguous across the national forest and are dominant features in the SAA area (SAMAB 1996:28).

At the time of the SAA, National Forest System lands had only 3% of forest habitats in the early successional stage, while 89% was in the mid- and late successional classes; 45% of this was late successional forest (SAMAB 1996:168). Other public lands were similar to the National Forest. Conversely, private industrial lands had 22% in early successional forest and only 4% in late successional forest; private non-industrial had 8% in early successional forest and 9% in late successional forest (SAMAB 1996:168-169). The 20-year trends (SAMAB 1996:28) show early successional forest on National Forests decreasing by 4%, with late successional forest increasing by 34%. Trends for private forests are mixed, with increases in both early- and late successional forest percentages. These results likely reflect the mixed objectives of private landowners, with some focusing on commodity production and others on amenity values. In general, on National Forest System lands forest conditions are weighted heavily toward total acres of older forests, while private forests are providing a more balanced distribution of forest successional conditions from young to old (Trani-Griep 1999).

Quality of forest successional habitats may also vary between private and national forest system lands. Objectives on national forests to provide for wildlife habitat needs, recreational activities, scenic integrity objectives, and water quality often result in greater vegetation structure retained in early successional forests than in similar habitats on private lands. On private lands, more intensive management may simplify structure and composition, reducing habitat quality. Similarly, effort to restore and maintain desired ecological conditions and processes in mid- and late successional forests also often enhances habitat quality over that found on private lands. For these reasons, conclusions regarding cumulative habitat availability from both private and national forest system lands must be made with caution.

Hurricanes (Foster 1992), lightning frequency (Delcourt 1998), fire frequency (Whitney 1986), and pre-settlement cultural activities (Delcourt 1987) were probably the major sources of disturbance events that created early successional forests prior to European occupation. Less drastic perturbations such as mortality events from tornadoes, insect or disease outbreaks, or defoliation (passenger pigeon roosts) were typically less extensive and cyclic but nonetheless provided a source of early successional 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." In a recent review paper by disturbance ecologist Craig Lorimer (*Historical and ecological roles of disturbance in eastern North American forests: 9,000 years of change*. Wildlife Society Bulletin 2001, 29(2):425-439), Lorimer states that predicting frequency of more severe natural disturbances (the kind that would created desired early-successional forest patches) is difficult because they are highly episodic and spatially heterogeneous. Lorimer goes on to state: "…the episodic nature of large natural disturbances creates a sort of 'feast or famine' environment that may subject early successional animal populations to erratic fluctuations…" Such feasts and famines may be especially extreme when looking at the smaller natural landscapes represented by national forests, surrounded by private lands that may be converted to nonforest. Successional forest objectives are designed to reduce the feast and famine swings for early-successional forest species, while providing ample habitat for mature forest species.

Overall, landscape patterns more consistently contain a component of early successional 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 have drastically altered the variables that would perpetuate a landscape with a significant component of early- successional 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 early successional forest conditions. At the same time, many of these same factors, especially land use conversion, have reduced the distribution and abundance of quality late successional forests across the larger landscape. Maintenance of these on public lands is equally imperative.

Currently the Jefferson National Forest only is comprised of about 1% early successional habitat, 8% sapling/pole habitat, 38% mid-successional, and 52% late successional and older stands. This is broken out in Table 3-39 by forest community type and successional forest condition. It is evident the forest is maturing faster than disturbance is creating young forest. Those early successional dependant species, such as the eastern towhee, prairie warbler, white-eyed vireo, and golden-winged warbler will be less common without management activity or widespread damage from weather and insect events. The old growth component on the Forest will increase as a result of identification and protection of existing old growth, and acreage comprising a variety of prescriptions that will not be actively managed through timber harvest.

Table 3-39. Current percentages of forested acreage on the Jefferson National Forest in each successional stage by forest community type as of 2002

Forest Community Type	Successional Stage			
	Early	Sap-ling /	Mid	Late
Northern Hardwood Forest	0	7	69	24
Conifer-Northern Hardwood Forest	6	41	27	26
Mixed Mesophytic Forest	3	15	45	37
River Floodplain and Eastern Riverfront Forest	0	4	76	20
Dry-Mesic Oak Forest	1	9	43	47
Dry and Xeric Oak Forest; Woodland and Savanna	1	4	34	61
Xeric Pine & Pine-oak Forest & Woodland	0	0	7	93
Dry and Dry-mesic Oak-pine Forest	1	5	37	57
Montane Spruce-fir Forest	0	0	78	22
All Community Types	1	8	38	53

MANAGEMENT INDICATORS

Indicators of conditions related to successional forest habitats are acreage or percent of forested acres on the National Forest within three categories of forest successional stages: 1) early successional forest; 2) mid- and late successional forest combined; and 3) late successional forest alone. These three indicators are selected because they are most relevant to describing important habitat conditions. Early successional forests are a key condition required by many species, and their level indicates near-future presence of sapling/pole successional stages as well. Because most species associated with late successional conditions will also be found to some extent in mid-successional forests, the combined level of these successional stages provides an indication of the total base of habitat available for these species. However, because late successional forest conditions will often provide better quality habitat for these species, a focus on levels of this stage alone is also meaningful.

The eastern towhee (*Pipilo erythrophthalmus*) is selected as a management indicator species (MIS) to represent early successional forests. Because the mid- and late successional forest habitats support more divergent communities depending on their composition, management indicator species for these habitats are identified and analyzed under the individual major forest community sections of this document. In addition, the chestnut-sided warbler (*Dendroica pensylvanica*) is selected as a MIS to represent early successional forest at higher (> 3,000 feet) elevations.

Eastern towhees nest in thickets or brushy places on the ground or in shrubs or saplings to five feet high and are found throughout the region and the Jefferson National Forest

(Hamel 1992). Eastern towhees require shrubs, saplings, or understory trees in a wide variety of situations, usually where a thicket is present. Towhees require dense shrubby cover. Populations respond favorably to conditions created three years following forest regeneration in larger forest patches (Thompson and Fritzell 1990).

Chestnut-sided warblers favor second growth woods and overgrown fields in which they locate their nest in a deciduous sapling one to five feet off the ground (Hamel 1992). Chestnut-sided warblers feed on insects gleaned from leaves and twigs; most foraging is done in saplings, shrubs, and in low trees. Providing a sustained flow of regenerating forests is necessary to support populations of chestnut-sided warblers and eastern towhees.

Direct and Indirect Effects

SUCCESSIONAL MIX CLASS OPTIONS

To guide provision of forest successional habitats and to facilitate effects analysis, four different mixes of successional forest conditions were defined and assigned to prescriptions, which were then allocated to national forest system lands. These four options describe objectives for percentages of early successional forest to be provided by natural causes or management actions, percentages of mid- and late successional forests combined (including old growth), and percentages of late successional forest (including old growth). Objectives were set for these measures because these were deemed the most meaningful measures of habitat availability for dependent species. The options were designed to cover the full spectrum of successional mixes needed to cover the range of preferences documented for forest-associated species. In other words, if each of these options is allocated to some portion of the landscape, all forest-associated species should find some portion of the landscape with optimal successional forest mixes.

- Option 1 was assigned to those areas for which there are no specific objectives for creating early successional forests through management actions. These areas would be expected to provide primarily mid-and late successional forest habitats in the short-term, with late successional forest conditions eventually predominating.
- Option 2 is also assigned to areas with no specific objectives for early successional forests, but creation of such habitat through management action may provide up to 4% of forested acres in early successional forest conditions, where compatible with the emphasis of the prescription. These areas have an objective of a minimum of 75% of forested acres in mid- and late successional forest and a minimum of 50% in late successional forest. Therefore, these areas also are expected to become dominated by late successional forests over time.
- Option 3 areas are characterized by objectives to create an intermediate mix of forest successional stages, with 4 to 10% of forested land in early successional forest condition. Objectives for older forests in these areas are to maintain a minimum of 50% of forested acres in mid- to late successional forest and a minimum of 20% in late successional forest.
- Option 4 areas are characterized by a mix of forest successional stages, with an emphasis on early successional forests. Objectives are to maintain 10 to 16% of forested acreage in early successional, 20% in mid-and late successional forests, and 10% in late successional forest. Expected percentages of successional forest conditions by option are summarized in Table 3-40.

Allocation of these successional mix options to national forest system lands are assigned by individual management prescriptions; and therefore, varies among the alternatives.

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Table 3-40. Desired percentage of forested acreage in early successional, mid- and late-successional, and late-successional habitat by successional mix options allocated to national forest system lands

Successional Mix Option	Early	Mid and Late	Late
1	0	100	100
2	0-4	>75	>50
3	4-10	>50	>20
4	10-17	>20	>10

Forest-wide mixes of successional habitats by alternative may be compared by viewing the acreage allocated to each of these four successional mix options (Table 3-41). These allocation percentages represent unconstrained attainment of forest successional stage objectives, and provide one way to compare alternatives. These options were used as successional constraints in the SPECTRUM model. (See Appendix B for more information regarding the allocation of successional mix option to each management prescription and use in the SPECTRUM model).

It is evident that Alternatives C, G, and E have the potential to result in the least amount of early successional habitat being created over the next ten years based on the distribution of successional class options. Conversely, Alternative D and F have the potential to result in more early successional habitat being developed. Successional options for alternatives A, B, and I are distributed similarly.

Table 3-41. Percent of total forest acres allocated to successional stage options 1, 2, 3, and 4, by alternative

Alternative	Forest Successional Option			
	1	2	3	4
A	45	14	27	14
B	54	3	39	4
D	37	0	29	34
E	60	26	11	3
F	39	2	24	35
G	69	11	19	1
I	51	4	36	9

SPECTRUM modeling provides a means for examining attainment of desired successional mixes at particular points in time within the constraints of other factors such as existing age-class distribution. Modeled mixes of successional stages at 10 and 50 years of plan implementation vary by alternative due to the differences in management intensity and emphasis (Table 3-42, Table 3-43, and Table 3-44). These tables show that even though there are differences between alternatives, that all alternatives except D, result in more late successional habitat being present over the next 50 years.

Because of the association of breeding eastern towhees and chestnut-sided warblers with early successional forests, both species populations are expected to vary by alternative in direct relation to the abundance of this successional stage. Table 3-45 shows the expected response of eastern towhee and chestnut-sided warbler populations to each of the alternatives. Their response is associated with levels of early successional habitat displayed in Table 3-42. This trend is consistent for both high and low elevational habitats.

Table 3-42. Expected percent of forested acreage in early successional forest conditions after 10 and 50 years of implementation

Alternative	Percent of Forested Acres Year 10	Percent of Forested Acres Year 50
A	2.9	1.3
B	2.3	1.6
D	4.4	3.0
E	0.5	0.1
F	2.9	2.6
G	0.4	0.4
I	2.1	2.3

Table 3-43. Expected percent of forested acreage in mid– and late-successional forest conditions after 10 and 50 years of implementation

Alternative	Percent of Forested Acres Year 10	Percent of Forested Acres Year 50
A	90	91
B	90	92
D	89	80
E	92	98
F	90	89
G	93	99
I	90	92

Cumulative Effects

Table 3-44. Expected percent of forested acreage in late-successional forest conditions after 10 and 50 years of implementation

Alternative	Percent of Forested Acres Year 10	Percent of Forested Acres Year 50
A	72	80
B	72	83
D	71	69
E	74	91
F	72	79
G	75	92
I	72	83

Across the landscape in which the national forest exists, cumulative mixes of successional forests will be affected by actions on private lands, and results of insect and disease outbreaks and storms that serve to create relatively large patches of canopy tree mortality. Although outbreaks and storms are difficult to predict, levels of these influences and private land factors are not expected to vary across alternatives. These external factors would be considered in site-specific planning under all alternatives to moderate cumulative effects. Early successional forests created by outbreaks or storms would be included in calculations of existing conditions, which would be used to determine whether management actions are needed to meet early successional forest objectives. If objectives are met through these unplanned events, creation of additional early successional forest by management action would not be planned. Presence of quality successional forest habitats on surrounding private lands, to the extent they can be known, would be considered during site-specific planning to determine where within the range of successional forest objectives is most desirable for national forest system lands. However, in order to provide for the diversity of plant and animal communities on national forest land and support viable populations on

Table 3-45. Expected population trends[1] of both the eastern towhee and chestnut-sided warbler on the JNF after 10 and 50 years of implementation for all alternatives. Population trend estimates are based on expected trends in habitat quantity and quality.

Time Period	Alternative A	B	D	E	F	G	I
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.

lands covered by the plan, as required by the National Forest Management Act and the 36 CFR 219 regulations, effort would be made under all alternatives to achieve successional mixes on national forest system lands that are within the objectives or desired conditions of each allocated prescription and its associated successional mix option. Although exact mixes would vary somewhat across alternatives as described in the preceding section, when viewed cumulatively across the landscape, it is expected that the national forest system lands would provide the majority of late successional forests and private land would provide a greater proportion of early successional forests under all alternatives.

OLD GROWTH

The Jefferson National Forest has been conducting an inventory of existing old growth since 1989. Forest Service policy and the proposed development of a large powerline right-of-way provided the incentive to conduct a preliminary inventory, and the existence of 1930s aerial photography of much of the Jefferson National Forest provided a means to conduct this inventory. The use of the aerial photos allowed for areas to be eliminated for consideration of old growth as well as identify potential areas. To date, over 50,000 acres of existing and/or potential existing old growth has been identified.

The provision of old growth, along with its amount and distribution, was identified as a public issue common to each of the five forests in revision in the fall of 1996. At the same time, Forest Service efforts were underway to provide regionally consistent guidance for addressing old growth in plan revisions.

SUMMARY OF OLD GROWTH GUIDANCE

In 1989 then-Chief Dale Robertson issued a national position statement on old growth. Beginning in 1990, the Southern and Eastern Regions of the Forest Service national forest system; the Forest Service Southern, Northeastern, and North Central research stations; and The Nature Conservancy began efforts to develop science-based old growth definitions for the east. The effort proved to be problematic in large part because so few representatives of old growth conditions exist and their history for their entire life so poorly known that quantifying the range of natural variability was imprecise. But after five years of effort, in December of 1995, the Southern Regional Forester chartered the Region 8 Old Growth Team to make the draft scientific old growth definitions ‘operational and useful’. In June of 1997 the Team completed a report entitled *Guidance for Conserving and Restoring Old-Growth Forest Communities on National Forests in the Southern Region*, hereafter called the ‘old growth report’ (Forest Service, 1997).

The old growth report gave operational definitions for sixteen old growth community types that encompassed nearly all of the forest cover types in the Southeast. A few were considered as rare communities and the tropical forests of the Caribbean were not included. The operational definitions established four criteria which had to be met before a stand would be considered ‘existing’ old growth: (1) AGE - a minimum age in the oldest age class; (2) PAST DISTURBANCE - no obvious human-caused disturbance that conflicts with old growth characteristics; (3) BASAL AREA - minimum basal areas of stems 5” d.b.h. and larger; and (4) TREE SIZE - a minimum diameter at breast height (d.b.h.) of the largest trees. Except for number two, the values for these criteria varied by old growth community type. The report also generally charged each Forest to provide: (1) a distribution of large (more than 2,500 acres), medium (100 thru 2,500 acres), and small (10 thru 99 acres) potential old growth patches; and (2) representation of all potential old growth forest community types for each ecological section unit. An exception to the large block requirement was made for forests in the Northern and Southern Cumberland Plateau and the Appalachian Piedmont ecological sections because of land ownership patterns. The distribution guidance did not specify an amount, such as acres or percent of area. In addition, old growth patches were assumed to be occurring on National Forest in a matrix of mid- to late successional forest conditions, providing connectivity without old growth allocations being physically contiguous. Representation was limited to ensuring that old growth community types were present, not a total amount nor an amount per each community. Amounts (i.e. acres) were to be based on public issues and ecological capabilities of the land.

THE BIOLOGICAL SIGNIFICANCE OF OLD GROWTH

As of 2002, no species had been identified in the Southeastern United States that were considered old growth obligates; that is, requiring old growth for some portion or all of their life cycle. Therefore, the provision of existing or future old growth is not directly linked in a cause and effect relationship to the viability of any species.

However, old growth is a condition that is particularly rich in habitat attributes for a variety of wildlife and these attributes occur in close association (intra-stand) with one another as opposed to a landscape scale (inter-stand) distribution. A wider variety of habitat niches are available than in earlier life stages of the same community. The long development period with low disturbance is conducive to the formation of multiple canopy layers that may include 'emergent' trees, dominant and co-dominant trees, suppressed trees, and a forest floor shrub layer. Canopy gaps of various sizes caused by: (a) the death in-place of a single tree; or (b) the deaths in-place of small groups of trees; or (c) the falling of a group of trees, in comparison with their immediate surroundings provide micro-sites with higher light regimes, higher stem counts, and an 'edge effect' both around the edge of the gap and back into the surrounding stand. Standing dead trees provide large and small diameter snags for foraging, perching, and cavity excavation. Down logs and limbs provide a substrate for wood decomposing fungi and insects; cover for small mammals, amphibians, and insects; and in later stages a 'nurse log' for the establishment of new tree seedlings. Large-diameter living trees, with a long-term exposure to natural damaging agents, have the potential through wood-rotting fungi activity for the formation of large cavities suitable for bear, raccoon, squirrel, bats, or other cavity users. The heavy limb structure that develops in some tree species as they age provides sturdy nest platforms for species such as bald or golden eagles.

THE SOCIAL SIGNIFICANCE OF OLD GROWTH

Whether biologically necessary to species or not, old growth is of value. There seems to be a general sense that it is intelligent to be sure to have the habitat on the landscape. In Aldo Leopold's words, '*The first rule of intelligent tinkering is to keep all the parts.'* As with Wilderness, there also appears to be a desire for places almost completely unmodified by humans whether or not those holding such a value ever visit them; that is, an 'existence' value. There can often be a historical, cultural or spiritual value associated with old growth. There also is value in providing old growth on a landscape scale that each person holding that value can readily relate to. That is, it is not enough to say something valued is being provided 'somewhere'.

In more pragmatic terms, old growth has other recognized social values. It is a desirable recreation setting, both for its biological variety and for the associated state of mind from knowing one is in an 'old growth' setting. It serves as a 'biological time machine' in that it is a reference area for what ecologically-comparable areas may have been previously and can be restored to given a similar amount of time and disturbance history. They are a valuable part of showing a comprehensive whole of ecological dynamics in conservation

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education. They are a source of scientific information, such as through tree ring analysis.

IMPLEMENTATION OF OLD GROWTH GUIDANCE IN FOREST PLANS

The Jefferson National Forest has used the Regional Guidance to help in the delineation of old growth. Small and medium sized patches have been identified. Existing wilderness, recommended wilderness study areas, and other old growth compatible prescriptions, such as backcountry, provide for the large blocks.

Affected Environment

Existing old growth was defined by the old growth report as 'forest stands that meet all four criteria (age, disturbance, basal area, and tree size) described in the operational definitions.' Of course this meant within its applicable old growth community type.

Potential old growth polygons were identified from the historic 1930s aerial photography. For those photos that were missing locally, a visit to the National Archives in Beltsville, Maryland, helped in the effort to identify potential areas from the old photographs. Most of these polygons were then visited, in an effort to verify the existence of old growth. Many areas indeed met the criteria, but many areas had been harvested since the 1930s. The current inventory is thought to be very accurate; except that it is likely that additional small patches of old growth may be found during implementation of the Forest Plan. Table 3-46 displays the current total acres thought to exist for each of the old growth community types. These numbers will change during the implementation of the Forest Plan as additional areas are found.

The distribution of old growth by community type, spatially and by patch size, is of importance. As of October 6, 2003, the inventory of old growth identified 556 small patches (1-99 acres) and 112 medium sized patches (100-2,499 acres) of old growth across the Forest. The mean size of small patches was 29 acres and 302 acres for medium sized patches. Medium sized patches ranged in size from 100 to 2,368 acres in size. There are no existing large (>2,500 acres) patches of old growth found on the Jefferson National Forest.

Table 3-46. Amount of existing old growth by old growth community type as of 2002

Type No.	Forest Community Type	Acres of Existing Old Growth	Total Acres of Community Type	Percent of Total Community Type	Percent of Total JNF Forested Acres
1	Northern Hardwoods	2,000	16,850	12%	0.3%
2	Conifer-Northern Hardwood	900	21,350	4%	0.1%
5	Mixed Mesophytic	4,700	83,990	6%	0.7%
13, 28	River Floodplain/ Eastern Riverfront	13	320	4%	0.0%
21	Dry- Mesic Oak	21,800	269,140	8%	3.1%
22	Dry and Xeric Oak	10,300	120,330	9%	1.5%
24	Xeric Pine and Pine Oak	1,300	41,510	3%	0.2%
25	Dry and Dry Mesic Oak-Pine	8,800	146,670	6%	1.2%
31	Montane Spruce-Fir	120	4130	3%	0.0%
TOTAL		49,993	704,290		7.1%

Direct and Indirect Effects

Existing old growth identified in the Forest Plan will be considered unsuitable for timber production. Thus, existing small and medium sized patches will provide quality habitat for primary and secondary cavity users and a variety of other wildlife species that use late successional and small canopy gap type habitats.

The use of prescribed fire to maintain and manage for native plant communities will result in prescribed fire being used in old growth areas, especially the yellow pine and oak community types. Where used, this could help perpetuate existing dominant tree species.

Since existing small and medium sized patches of old growth will be unsuitable, no difference is expected between alternatives on this resource. However, the delineation of old growth compatible prescriptions will result in differences among the alternatives in providing for large blocks of future old growth.

Each alternative evaluated in detail includes management prescriptions that either have the primary intent of protecting possible old growth and expanding it, or of providing old growth indirectly as the result of management focused on other values, such as primitive recreation. But, as noted in the old growth report, the primary focus of old growth management in the near and medium term is restoring it on the landscape. And the primary (not the only) component of restoration is simply time; time for existing stands to age through the gradual development of old growth conditions. For that reason, alternatives are compared by the sum of the acreage they allocate to old growth compatible prescriptions, and the number of blocks greater than 2,500 acres within each.

Table 3-47. Acreage in Old Growth Compatible Management Prescriptions that will provide for large blocks (>= 2,500 acres) of future old growth, by Alternative

Management Prescription		Alternative (acres)						
		A	B	D	E	F	G	I
1A	Existing Wilderness	57,800	57,800	57,800	57,800	57,800	57,800	57,800
1B	Recommended Wilderness	28,200	14,200	15,400	81,000	0	148,600	15,600
12C	Backcountry Natural Processes	0	1,600	0	0	0	3,200	7,500
12B	Backcountry Non-Motorized	45,300	44,600	6,900	37,700	19,200	4,100	79,600
12A	Backcountry Few Open Roads	2,900	0	1,800	6,100	36,400	10,600	5,300
Total Acres		134,200	118,200	81,900	182,600	113,400	224,300	165,800
Percent of Total JNF Forested Acres		18%	16%	11%	25%	16%	31%	23%

Unit of Measure	A	B	D	E	F	G	I
Number of Blocks	22	20	15	23	24	24	29
Total Acres	134,207	118,236	81,891	182,605	113,350	224,347	165,838
Average Block Size	6,100	5,912	5,459	7,939	4,723	9,348	5,719
Minimum Block Size	2,789	2,549	2,758	3,151	2,527	3,151	2,613
Maximum Block Size	16,305	12,908	11,952	23,198	11,380	26,124	17,613

It is evident from Table 3-47 that Alternative G provides for the greatest potential of old growth being found in large blocks in the future. This alternative contains the greatest acreage within potential future old growth blocks greater than 2,500 acres. It also would contain the largest potential block. This was followed by Alternatives I and E respectfully. Alternative D provides the least amount of potential old growth found in large blocks. The actual number of large blocks varies by alternative as does average block size (Table 3-47). For example, Alternative I would have approximately 29 areas of at least 2,500 acres in size comprising the acreage seen in Table 3-47. These large blocks would range in size from 2,613 acres to 17,613 acres with a mean size of 5,719 acres.

Cumulative Effects

The biggest impact upon existing and future old growth will be weather and insect and disease events. Gypsy moth, southern pine beetle, and the hemlock woolly adelgid induced mortality is expected to severely impact certain old growth communities. In addition, the last three years of drought have stressed trees to the point where mortality has been observed. But, regardless of alternative, the maturation of the Forest will continue and an increase in old growth is expected over the next 10 years. Continued inventory for small patches of old growth will occur at the project level, and this is expected to result in a slight increase in documented old growth acres.

PERMANENT OPENINGS, OLD FIELDS, BALDS, RIGHTS-OF-WAY, AND IMPROVED PASTURES

Habitats considered here include permanent openings, old fields, utility rights-of-way, and improved pastures. Other early successional habitats such as woodlands, grasslands, and early successional forests are discussed elsewhere in this document.

PERMANENT OPENINGS, OLD FIELDS AND BALDS

Permanent grass/forb and seedling/sapling/shrub habitats are important elements of early successional habitat. Permanent openings typically are maintained for wildlife habitat on an annual or semi-annual basis with the use of cultivation, mowing, or other vegetation management treatments. These openings may contain native grasses and forbs or may be planted to non-native agricultural species such as clover, orchard grass, wheat, or small grains. Old fields are sites that are no longer maintained, are maintained on a less frequent basis (5-10 year intervals, usually with burning and mowing) or are succeeding to forest. They are largely influenced by past cultural activities and may be dense sod or a rapidly changing field of annual and perennial herbs, grasses, woody shrubs and tree seedlings.

Permanent openings are used by a variety of wildlife, both game and non-game species. Parker and others (1992) reported use of agricultural openings by 54 species of birds and 14 species of mammals in a study on the Chattahoochee National Forest. Bird species observed included wild turkey, several species of raptors and woodpeckers, and numerous songbirds including a number of neotropical migrants such as pine warbler, ovenbird, and black-throated green warbler. The greatest number of avian species and highest bird species diversity was found within the edge zone of the openings. Mammals observed included species such as white-tailed deer, striped skunk, woodchuck, bobcat, black bear, red bat, eastern cottontail, opossum, and several other small mammals.

The benefits of permanent openings to white-tailed deer are well documented. Permanent openings, especially those containing grass-clover mixtures, are used most intensively in early spring, but also are an important source of nutritious forage in winter, especially when acorns are in short supply (Wentworth et al. 1990, Kammermeyer et al. 1993). Kammermeyer and Moser (1990) found a significant relationship between openings and deer harvest with only 0.13% of the land area in high quality openings. Forest openings also are a key habitat component for wild turkeys throughout the year (Thackston et al. 1991, Brenneman et al. 1991). Maintained openings provide nutritious green forage in the winter and early spring and seeds during late summer and fall. Because of the abundance of insects and herbaceous plants produced in these openings, they are especially important as brood rearing habitat for young turkeys (Nenno and Lindzey 1979, Healy and Nenno 1983). Linear openings, especially those associated with young regenerating forests, provide optimal brood habitat conditions for ruffed grouse (Dimmick et al. 1996).

There also are numerous wildlife benefits from openings maintained in native species. Native warm season grasses provide nesting, brood-rearing, and roosting habitat for northern bobwhite and other grassland species of wildlife (Dimmick et al. 2001). Native species are well adapted to local environments and generally require less intensive maintenance following establishment.

Old fields provide food and cover for a variety of wildlife species. A number of disturbance-dependant birds, such as northern bobwhite, grasshopper sparrow, golden-winged warbler, and blue winged warbler, are associated with old field habitat (Hunter et al. 2001). Recently abandoned fields are important for rabbits and many small mammals (Livaitis 2001). Woodcock use old fields as courtship, feeding, and roosting sites (Straw et al. 1994, Krementz and Jackson 1999). Although managed less intensively than other types of permanent openings, some degree of periodic management is necessary to maintain these habitats.

There currently are approximately 11,964 acres of permanent openings (including old fields) on the Jefferson National Forest (Table 3-48). This represents 1.65% of the total national forest acres for the Forest. A number of the openings are old farm sites that were in cultivation when the lands were acquired by the Forest Service. Others were created by the expansion of log landings following timber harvest or by closing and seeding old roads to create linear openings. The Virginia Department of Game and Inland Fisheries maintains most of the permanent openings with their personnel. Many are planted in high quality grass-clover mixtures, which include combinations of white and red clovers along with wheat, rye, oats, orchard grass, and ryegrass. Some of the older openings are dominated by fescue and/or annual weed species, but some of the recently renovated openings are planted to orchard grass/clover. In addition, there are approximately 2,520 acres of high elevation open areas (balds) that serve as open and semi-open wildlife habitat.

Table 3-48. Current acreage and percent of total forest acres of permanent openings on the Jefferson National Forest as of 2002

Types of Permanent Openings	Acres	Percent of JNF
Rights-of-way	3,576	0.49%
Improved Pastures	3,816	0.53%
Balds	2,520	0.35%
Wildlife Openings and Old Field Habitats	2,052	0.28%
TOTAL	11,964	1.65%

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RIGHTS-OF-WAY AND IMPROVED PASTURES

Utility rights-of-way (ROWs) and improved pastures typically are managed for purposes other than to provide wildlife habitat. However, they can provide wildlife benefits if managed appropriately. Rights-of-way can be established and maintained in plantings that enhance their benefits to wildlife. Once established, ROW maintenance costs generally are reduced. The conversion of fescue pastures to native warm season grasses improves habitat conditions for northern bobwhite and numerous grassland species (Dimmick et al. 2001).

Although pastureland acreage has declined over the last 50 years, pastures still comprise approximately 7 percent of the Southeastern United States (USDA Forest Service 2001). For the Southern Appalachian Assessment Area, pastures comprise approximately 17 percent of the area, 99 percent of which is on private land (SAMAB 1996). There are no comparable estimates for rights-of-way.

The current acreage in utility rights-of-way and improved pastures is shown in Table 3-48. There are 3,576 acres of rights-of-way on the Jefferson National Forest. The majority of these ROWs is in a mixture of herbaceous plants and shrubs and is maintained by periodic mowing/saw down. There are 3,816 acres of improved pasture on the Jefferson National Forest. A majority of these acres are located on the Mount Rogers National Recreation Area.

Direct and Indirect Effects

PERMANENT OPENINGS, OLD FIELDS, AND BALDS

Permanent wildlife openings will be maintained through all Alternatives unless within identified wilderness study areas. Alternative I has no permanent openings within any wilderness study areas. Alternative G, which contains the most additional wilderness, impacts this component the most. Thus, hunter success and satisfaction may be reduced under Alternative G.

Balds management is eliminated under Alternative G, and approximately half of the acreage is eliminated under Alternative B. The remaining alternatives retain the existing acres of balds. Under Alternatives B and G, the acres of balds management eliminated would likely succeed to spruce-fir and northern hardwood habitat, which would be beneficial for the northern flying squirrel. Table 3-92 under the Terrestrial Viability Analysis later in this chapter shows that are 15 species associated with grassy balds, where nine species are rated as having a very high viability risk, three species are rated with a high risk, and three species are rated with a moderately high risk. Three species are associated with shrub balds, where 1 species is rated with a very high viability risk, one species with a high risk, and one species with a moderately high risk.

Alternatives eliminating or reducing old field habitat would impact the assemblage of bird species requiring early successional habitats the most.

Table 3-49. Projected acreage and percentage of permanent openings at 10 through 50 years of forest plan implementation by alternative

Permanent Openings	Alternative Decades 1 through 5						
	A	B	D	E	F	G	I
Acres	11,810	9,299	11,810	11,795	11,810	6,788	12,079
Percent	1.60%	1.30%	1.60%	1.60%	1.60%	0.90%	1.70%

RIGHTS-OF-WAY AND IMPROVED PASTURES

In general, existing utility rights-of-way will be treated similarly under all alternatives. Right-of-way typically are managed by third parties who should be encouraged to manage these to the extent possible to enhance their value to early successional species. In addition, forest-wide standards have been established that prohibit broadcast herbicide application for maintenance and require site-specific environmental analysis prior to maintenance operations.

Cumulative Effects

Permanent openings, old fields and balds are a very important habitat element for a variety of wildlife species including both game and non-game species. However, they comprise a very small (1.6%) percentage of the landscape of the Jefferson National Forest. The habitat conditions provided in these areas are very different from that provided by lawns, ball fields and golf courses that are much more common on adjacent private land. Generally, the openings on private land are not maintained in the high quality grass-clover mixtures available in the permanent openings. Therefore, most of the openings on private land do not provide comparable benefits to wildlife. In addition, the Forest Service does not have control of the management of the openings on private land. Areas that currently provide habitat may be developed in the future and therefore cannot be relied on to provide long-term wildlife benefits. It therefore is important to maximize the benefits from this limited acreage on the Forests by maintaining these openings in high quality habitat conditions. Other open-land habitats such as rights-of way and improved pastures are very abundant on private land. Because of the abundance of these habitats on private land, management of these habitats is not a major focus of National Forest management.

INTERIOR HABITATS

Habitat fragmentation is a key issue for viability of local populations of breeding birds in some mature mesic deciduous forest settings. Birds in this group (Appendix E, Forest Interior Birds) avoid forest edges during nesting and are adapted to forest interior conditions. Most are neotropical migrants that primarily nest and raise young in the temperate Americas. These species are grouped for effects analysis due to their sensitivity to forest fragmentation and edge effects (Hamel 1992: Appendix F, G1-G2).

Studies conducted in the mid-western U.S. have documented that forest interior species may not successfully breed in small patches of otherwise suitable habitat. Quality of their forest interior habitat is measured in part by proportion of edge, an artifact of juxtaposing forested and non-forested habitats. Edges fragment forest interior habitats and are associated with increased predation and brood parasitism by the brown-headed cowbird in agricultural settings (Primack 1993; Yahner 1998). However, characteristics of the surrounding landscape, such as percent forest cover, determine the magnitude of local edge effects. Findings of Robinson and others (1995) indicate that large landscapes with at least 70-80% forest cover offer high potential as quality habitat for forest interior species, where adverse effects of edge are reduced to levels compatible with productive populations.

Donovan and others (1997) found that abundance of the brown-headed cowbird in a midwestern U.S. setting was significantly greater in highly fragmented landscapes (< 15% forested) than in moderately fragmented (45-55% forested) or unfragmented (>90% forested) landscapes, but abundance in moderate and unfragmented landscapes did not differ. Landscape-scale habitat patterns significantly influenced overall nest predation patterns and cowbird abundance. However, local effects of livestock grazing and horse corrals caused high variation between landscape units with similar percent forest

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characteristics. The specific types of non-forested habitats present may be important.

As a general rule, parasitism levels of 25% or less and daily nest predation rates of 4% or less should give most forest interior species "at least a chance" (Robinson 1995) of having self-sustaining local populations (also May and Robinson 1985; Donovan et al. 1995). Based on the work of Robinson and others (1995), these parasitism rates are associated with a minimum of 70-80% forest cover at a landscape (75,000 acre) scale for a midwestern U.S. setting.

Duguay and others (2001) found that in a forested setting in West Virginia (Monongahela National Forest, >88% 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 U.S." They also concluded that implementing relatively small cuts that create 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.

Other habitat factors are known to influence productivity of this species group. Presence of young forest patches within a forested landscape is likely to have positive benefits for immature birds. Vega Rivera (1998) and Anders and others (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. Scattered canopy gaps and associated dense understories likely were characteristic of old growth mesic deciduous forests. Open habitats such as pastures, old fields, and managed wildlife openings were rarely used.

The significance of National Forest System lands to this species group was analyzed at both regional and forest scales in the Southern Appalachian Assessment (SAMAB 1996b: 69-73). This analysis of forest interior habitat focused primarily on patterns of land use (forested vs. non-forested) and measures of edge effects at a landscape scale. Based on this analysis, there are approximately 9 to 10.5 million acres of suitable habitat in the Southern Appalachian Assessment (SAA) Area with about 4.7 to 5.4 million acres (52%) located within tracts greater than 5,000 acres.

Approximately 70% of suitable habitat and 51% of the largest tracts are privately owned, while 23% of suitable habitat and 39% of the largest tracts are on national forest land. A notable difference is found within the Blue Ridge Mountains, where approximately 40% of suitable habitat and half of the largest tracts occur on national forest land. Within the SAA area, the majority of forest interior habitat occurs within the Blue Ridge Mountains, followed by the Northern Ridge and Valley/Cumberland Mountains. The Southern Ridge and Valley and Southern Cumberland Plateau have the smallest relative amount (SAMAB, 1996b:73).

To determine the landscape context of the Jefferson National Forest, a shifting window analysis was conducted using 1990 National Land Cover Data (U.S. EPA 2002). Percent forest cover within a surrounding landscape of 75,000 acres (per Donovan et al. 1997) was calculated for each 90-meter grid cell located on the national forest and nearby private land. For this analysis, Deciduous, Evergreen, and Mixed Forest, and Woody Wetlands were classified as forested lands. All other land cover types, including recent clearcuts (transitional cover type), were classed as non-forest cover. This analysis indicates the great majority of the Jefferson National Forest occurs within a landscape that is more than 70 to 90% forested.

There are several areas within the Jefferson National Forest that have settings that are less than 70% forested, where edge effects could adversely affect productivity of forest interior birds. In all cases, either urban and/or agricultural influences create a landscape that is less than 70% forested. The cities of Marion, Wytheville, Pulaski, and Blacksburg in combination with agricultural activities result in landscapes that are dominated by non-forest habitats or are not considered dominated by forest. In addition, the agricultural landscape associated with Reed and Cripple Creeks in Wythe and Smyth Counties impact adjoining National Forest System lands within the New River Valley Ranger District and the Mount Rogers National Recreation Area. Also, the agricultural landuse northeast of Roanoke and south of Glade Springs likely influences landbirds using adjoining National Forest System lands. However, only 25% of the acreage found within these less than 70% forested landscapes are in prescriptions that would likely involve much active management over the next ten years. The 8A1 and 8C prescriptions account for a majority of this acreage.

Currently, the Jefferson National Forest provides 327,721 acres of mid- and late-successional mesic deciduous forest, comprising 46% of total forest acres. About 89% of total mesic deciduous forest acres are in mid- and late successional stages. Approximately 91% of the mid- and late successional stages of mesic deciduous forest is found in a landscape with greater than 70% forested habitat.

Direct and Indirect Effects

Implementation of forest plan alternatives would create edge in mesic deciduous forest interior habitats during creation of early successional forest habitats, road construction, some types of recreation development, and routine maintenance and permitting of small clearings including easements and rights-of-way. These edges could cause adverse effects to productivity of forest interior species in some settings.

Amount of edge generated would vary by alternative, particularly as caused by creation of early successional forest habitats in or near mid- and late successional mesic deciduous forests (Table 3-50). On the Jefferson National Forest, these older forests are allocated to prescriptions with medium and high objectives for early successional forest habitats at the highest rate in Alternative F, followed by D, then by Alternative B and I and then A. Alternatives E and G are expected to result in associated edge at lower levels than F, D, B, I and A.

In the short-term, adverse effects of edge are most likely to occur in the areas shown by analysis to be within landscapes less than 70% forested. Regardless of varying levels of edge created under plan alternatives, edge created on the rest of the forest is not expected to have significant short-term effects due to the current landscape context. High

Table 3-50. Percentage of mid- and late-successional mesic deciduous forest acreage allocated to prescription objectives for early successional forest by alternative

Prescription Objective	Alternative						
	A	B	D	E	F	G	I
None	53	58	48	67	43	73	58
Low (0-4% of area)	12	4	1	21	1	11	4
Medium (4-10% of area)	24	37	20	10	16	16	32
High (10-17% of area)	11	1	31	2	40	0	6

levels of forest regeneration on national forests could negatively shift percent of forest cover as calculated for this analysis; however, such effects would require simultaneous implementation of relatively high levels of regeneration over large landscapes. This situation is unlikely due to the prevalence of prescriptions with low to no early successional forest objectives. Alternative D, due to its abundant allocation of acreage to high early successional forest objectives, is most likely to result in this effect. No alternative includes high levels of forest conversion to other land use types, and therefore no meaningful long-term change in landscape cover type is expected due to direct or indirect effects of national forest management. In the long-term, effects of forest edge on the national forest will largely depend on the cumulative effects of land-use changes on private lands surrounding the national forest.

Alternatives that shift age-class distribution of mesic deciduous forests to younger age classes would have negative effects on interior birds through reduction in acreage of suitable habitat (Mesic Deciduous Forest Section, Table 3-15). Alternative D and F, which includes the highest rates of forest regeneration within this forest community, would most limit abundance of suitable habitat for these species. Conversely, Alternative G would result in the most acres and percentages in that same condition. The remaining alternatives would be very similar to Alternative G at the end of the first decade; ranging from 87% to 90% in a mid-late successional condition.

The creation of canopy gaps will enhance habitat conditions for a variety of species. The hooded warbler responds to the increased understory growth resulting from canopy gaps and thinnings. In addition, solitary vireos and American redstarts are known to increase in relative abundance as a result of group selection timber harvesting (Meehan 1996, Overcash 2003). Alternative E, and to a lesser extent Alternative I, will result in creation of more of this type of habitat. In addition, some positive effects may be expected where alternatives permit low to moderate levels of vegetation management for creation of young mesic hardwood forest patches, due to use of these habitats by fledgling birds for food and cover (Vega Rivera 1998, Anders et al. 1998). The relative balance of these positive effects and potential negative edge effects is dependent on the landscape context and the relative abundance of mature and young forests. On balance, effects are expected to be positive where mid- and late successional forests are common, and forest cover on surrounding landscapes predominate. The balance shifts to negative as landscapes go below 70% forest cover and young forests or forest openings become common.

MANAGEMENT INDICATORS

The ovenbird is the forest interior management indicator species. The expected response of this species to each of the alternatives is found in Table 3-51. The percentage of mid-late-successional mesic deciduous forest acreage allocated to prescriptions with no or low amounts of harvest planned (Table 3-50) helps identify which alternatives will have the greatest potential to benefit forest interior habitats and thus ovenbird populations. This component in combination with the percentage allocated to medium and high amounts of early successional habitat were the basis for relative comparisons of the impacts of each alternative on ovenbird populations. In addition, total acreage devoted to backcountry, wilderness and wilderness addition prescriptions (Table 3-47) were used to identify relative differences between alternatives. For example, Alternative I shows a positive benefit to ovenbirds within the next 10 years as a result of the large acreage identified in backcountry, and wilderness additions, but over the next 50 years, active management will occur on enough of the Forest that populations are expected to be similar to today. This is in comparison to Alternative G and E which have very little to none of mid and late-successional mesic forest found in prescriptions with medium or high objectives for early

Table 3-51. Expected population trend[1] of ovenbirds under forest plan revision alternatives 10 and 50 years following plan adoption. Population trend estimates are based on expected trends in habitat quantity and quality.

Time Period	Alternative						
	A	B	D	E	F	G	I
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.

successional forest. Thus, populations are expected to benefit the most from these two alternatives over the next 50 years.

Cumulative Effects

Regional Landscape Setting

Although the current supply of forest interior habitat on national forests within the analysis area is good to excellent (a range of 68% to 96% forest interior habitat; SAMAB 1996b), the context of land use trends is relevant, because conditions on surrounding private lands can adversely affect habitat suitability for forest interior bird on national forest land by increasing densities of cowbirds and nest predators. Currently, about 75% of the Southern Appalachian area is rural and privately owned. Forested private land within the region has declined by about 220,000 acres since 1982. Similarly, pasture and cropland have also decreased by about 300,000 acres. In contrast, developed acreage has increased by more than 600,000 acres, most prominently in the Blue Ridge and the Southern Mountain and Piedmont Sections (SAMAB 1996a).

Like agriculture and pasture land uses, developed acreage has a negative influence on forest interior species by encouraging nest predation (by crows and jays, mid-sized mammals including domestic cats) (Wilcove 1985; Crooks and Soule 1999; Hawkins 1998) and brood parasitism by cowbirds.

Rapid population growth, economic growth and diversification, better employment and wages, declining farming, and better housing translate into rising pressures on the natural resources of the Southern Appalachian region for the foreseeable future (SAMAB 1996a). New transportation corridors connecting communities will have direct and cumulative influences on development and subsequent loss of forested land.

Forested private lands adjacent to national forests reduce the influence of developed land on core areas of forest interior habitat on national forest. However, the continued forested condition is tenuous, and acreage will most certainly decrease. Future land use trends over the next 15 years will likely include a decrease in suitable forest interior habitat acreage found in large tract sizes, primarily due to development and increasing urbanization. The severity of edge effects and fragmentation will be most prominent in the currently agriculture-dominated landscapes (SAMAB 1996b: 72) especially in locations where national forest ownership occurs in small to medium patch sizes.

Jefferson National Forest Landscape Setting

Bird productivity is likely most secure from landscape-level edge effects in Bland and Craig

Counties, Virginia, which have low projected human population growth (SAMAB 1996b), a high percentage of public land ownership, and very consolidated patterns of public ownership. Bird productivity is least secure in Roanoke, Montgomery, and Washington Counties, Virginia, which are characterized by more rapid predicted growth, smaller acreage in public ownership, and more fragmented public land ownership (See the Demographic Factors under the Social and Economic Environment later in this chapter). In these counties critical social trends coincide with possible existing fragmented landscape conditions.

Because of land ownership patterns, the majority of the Jefferson National Forest is expected to remain within predominantly forested landscapes under all alternatives. Within these lands, mid- and late successional mesic deciduous forests are expected to be common under all alternatives, but least common for Alternative D (Table 3-16). Due to the combination of these factors, most national forest habitats are expected to support varying degrees of productive populations of forest interior birds under short-term implementation of all alternatives. As long as small regeneration areas and other openings constitute a relatively small proportion of the total landscape and cowbird foraging areas do not dramatically increase, most Jefferson National Forest System lands will likely continue to serve as source populations for surrounding, lower quality habitats for the foreseeable future. All alternatives would include monitoring of bird populations within these habitats, as well as changes in landscape context through re-evaluation of percent forest cover as new land cover data become available. Validation of forest interior bird productivity on national forests is a research need.

RIPARIAN HABITATS

This section focuses on terrestrial habitat aspects of riparian areas; aquatic aspects of these ecologically important areas are covered under assessment of watersheds and aquatic systems.

Terrestrial riparian habitats encompass the transition area between aquatic systems and upland terrestrial systems. All wetlands (including beaver ponds), as well as margins of varying widths along streams, rivers, lakes, ponds and reservoirs, are contained within terrestrial riparian habitats. These areas provide a number of critical functions for associated species. Most importantly, they provide rich, moist environments, not often found in upland areas. Riparian terrestrial habitats may serve as corridors for wildlife movement, allowing for daily travel and seasonal migration. The riparian area may serve as a connector of habitats and populations allowing gene flow to occur, thus keeping populations genetically vigorous (Harris 1988).

Riparian habitats ideally include a mosaic of native plant and animal communities and successional stages, with a predominance of late successional forests. Late successional riparian forests contain multiple canopy layers that provide a variety of ecological niches, thermal and protective cover, and maintenance of moist conditions. Decadence of older forests provide an abundance of snags and downed wood, which also help retain moisture and provide important habitat substrate for reptiles, amphibians, small mammals, invertebrates, and mosses and liverworts. The majority of riparian-dependant species need or prefer late successional forest conditions for the diverse structure and the moist, temperature-moderated microclimates they provide. However, some species require early successional or shrubby riparian habitats.

Disturbance regimes in riparian areas differ from those of adjacent uplands in important ways. Sheltered topographic positions and moist conditions generally reduce disturbance caused by wind and fire. Disturbance sources more common in riparian areas are beaver activity, and flooding and channel scour, especially along stream banks. These operate in addition to more universal factors, such as insect and disease outbreaks. One of the most important disturbance factors in riparian areas for at least the past thousand years is anthropogenic clearing, which, even prior to European settlement, was sufficient to create large areas of early successional riparian habitats such as canebrakes (Brantley and Platt 2001). Concentration of anthropogenic disturbances in riparian habitats was the result of the high fertility and level terrain of these areas. Such effects were likely most predominant along larger streams and rivers. Today, these same factors continue to drive anthropogenic disturbance in these areas. The value of these areas for human uses has resulted in many riparian zones along major watercourses remaining in private ownership while upper reaches were converted to public ownership. Prior to European settlement, anthropogenic disturbance along smaller streams, which are more typical of national forest system lands, was likely less extensive, resulting in a greater predominance of late successional conditions in these riparian areas. The challenge for federal land managers today is to try to restore, to the extent possible, the network of mature forest riparian corridors critical to many species and to water quality, while providing some level of quality habitats for those species adapted to early successional riparian habitats.

The Southern Appalachian Assessment (SAA; SAMAB 1996) included analysis of cover classes within 100 feet of watercourses for the entire study area. Satellite data with 30-meter resolution were used, resulting in only larger watercourses being detected. The 100-foot corridor width was selected due to the precision of the database and because riparian corridors of 100-160 feet can be useful for correlation of the riparian landscape to stream habitat and biological integrity (SAMAB 1996: 72). Based on this analysis, within the SAA study area there are approximately 2.3 million acres in the riparian zone. Land cover classes for the riparian study area were: 70% forested, 22% pasture/herbaceous, 3% cropland, 4.3% developed/barren, and 0.7% wetland. Ownership of land in the riparian zone in the SAA area is mainly private (approximately 85%), with national forests being the next major owner at approximately 10%. The remaining 5% is in national parks, the Cherokee Indians' ownership, other federal holdings, and state parks and forests (SAMAB 1996:71-74).

Riparian forest cover varied across the study area from more than 90% to less than 25%,

Table 3-52. Current acreage of riparian habitat along perennial and intermittent streams by community type and successional stage as of 2002

	Successional Stage (All Alternatives)					
Community Type	**Early**	**Sapling / Pole**	**Mid**	**Late**	**Old**	**Grand Total**
Conifer-Northern Hardwood	100	700	900	800	1,000	3,500
Dry and Dry Mesic Oak-Pine	100	500	4,700	5,900	900	12,100
Dry and Xeric Oak	0	400	2,700	3,800	1,900	8,800
Dry-Mesic Oak	200	2,200	10,400	11,600	600	25,000
Eastern Riverfront	0	0	100	0	0	100
Mixed Mesophytic	200	1,500	8,600	6,500	700	17,500
Montane Spruce-Fir	0	0	200	0	0	200
Northern Hardwood	0	100	1100	200	100	1500
River Floodplain	0	0	0	0	0	0
Xeric Pine and Pine-Oak	0	0	300	2,700	500	3,500
Non-Forest	1,100	0	0	0	0	1,100
Grand Total	1,700	5,400	29,000	31,500	5,700	73,300

with the Ridge and Valley ecoregion tending to have less forest cover in the riparian zone than the Blue Ridge and other ecoregions. The analysis also found that "[l]ands in federal ownership, such as national forests and national parks, have significantly more forest cover in the riparian zone than do lands in other ownerships."

On the Jefferson National Forest there are 73,600 acres of riparian habitat associated with perennial and intermittent streams (Table 3-52). This represents 10% of the total National Forest acres on this unit. Riparian areas are well distributed across the Forest and are important habitat elements that run through all management prescriptions.

Many terrestrial species of viability concern are associated with riparian habitats (Appendix E). Most are associated with late successional riparian forests, but some require the dense understories that result from open canopy or early successional conditions.

MANAGEMENT INDICATORS

The primary indicator used to assess terrestrial habitat conditions within riparian areas is forest-wide acreage of riparian corridors by successional stage. In addition, the Acadian flycatcher (*Empidonax virescens*) is selected as an appropriate management indicator species (MIS) for mid- and late successional riparian forest habitat. It requires deciduous forest near streams for breeding, and is not often found outside of these habitats during the breeding season (Hamel 1992:193). Its presence indicates riparian forests with relatively high levels of canopy cover and low levels of management disturbance–conditions required or preferred by many riparian associated species.

Direct and Indirect Effects

Under all alternatives, riparian corridors are managed under the Riparian Prescription. The prescription defines these corridors as 100 feet on either side of perennial streams and 50 feet on either side of intermittent streams, but also indicates that these corridors "should be expanded to include all of the true riparian area." Site-specific interdisciplinary analysis may vary this width to ensure that riparian values and functions are maintained. The management goal for riparian corridors is to maintain or enhance the structural and functional integrity of riparian areas and associated aquatic and upland systems. Riparian corridor characteristics important to structural and functional integrity for terrestrial wildlife include habitat connectivity; vegetation diversity (including age, species composition, and vegetation layer diversity), vegetation vigor, abundance of snags and woody debris, and a width that is adequate to retain riparian habitat functions (Knutson and Naef, 1997). Riparian corridors include the concept of buffering streams to retain important stream functions, but they also encompass the functional aspects of riparian areas relative to uplands. Therefore, they present the opportunity to manage riparian habitat as a more completely functioning system in which streams and uplands mutually influence each other (Knutson and Naef, 1997, Tiner 1999).

To provide for riparian integrity, management standards are included in the Riparian Management Prescription 11. These include provisions to provide desirable levels of woody debris and controls on impacts from grazing, recreational uses, mineral development, and fireline construction. Vegetation management is limited to that needed to maintain or improve riparian function within the core of the riparian area. On the outer slopes of the riparian corridor, vegetation may be managed to meet the objectives of the adjacent prescription area, though riparian standards are implemented to reduce impacts. Zones around channeled ephemeral streams are also recognized as special areas, with standards designed to ensure protection of channels and their function as part of the riparian network.

The desired future condition and standards for riparian forests provide for canebrake restoration and early successional habitat creation for community diversity where needed within riparian areas. Treatments to increase structural diversity, such as canopy gaps, are also allowed. These activities represent the vegetation management activities most likely to be implemented in riparian corridors. Levels of these activities would not vary across alternatives (Table 3-53), but would affect only a small proportion of riparian corridors, and would only be implemented where such conditions are lacking. Prescribed fire also may occur within riparian corridors, most often as low intensity backing fires, using streams as control lines. Because of their low intensity, these fires are not expected to substantially alter vegetation or leaf litter conditions. Where riparian corridors support fire-dependant communities (e.g. canebrakes), prescribed fire may be used more purposefully to maintain these communities.

Table 3-53. Expected levels of vegetation management activity within riparian corridors for the purpose of providing vegetation diversity for riparian-dependent biota, by alternative

Management Activity	Alternative						
	A	B	D	E	F	G	I
Acres of Canebrake Restored in First 10 Years	5	5	5	5	5	5	5
Acres of Canopy Gap Treatments in First 10 Years	50	50	50	50	50	50	50
Percent of forest-wide riparian corridors maintained in early successional condition	<1	<1	<1	<1	<1	<1	<1

Implementation of the riparian prescription under all alternatives is expected to increase the acreage within riparian corridors that is in late successional forest (Table 3-54 and Table 3-55) as a result of allowing forests in these areas to age. Increases in older forests would result in increases in abundance of snags and downed wood, important habitat components for many riparian-dependant species. It would also result in abundant and well-distributed habitats characterized by shaded, low-disturbance, moist-soil microsites, which are preferred habitat for a large number of species. Only small proportions of

Table 3-54. Expected percent of total riparian corridor acreage in each forest successional stage following 10 years of implementing forest plan revision alternatives

Forest Community Type	Successional Stage (All Alternatives)					
	Early	Sap / Pole	Mid	Late	Old	Total
Northern Hardwood Forest	0	20	540	800	140	1,500
Conifer-Northern Hardwood Forest	0	520	650	830	1,500	3,500
Mixed Mesophytic Forest	0	1,000	5,070	10,630	800	17,500
River Floodplain / E. Riverfront Forest	0	0	90	10	0	100
Dry-Mesic Oak Forest	0	1,660	5,580	15,530	2,230	25,000
Dry & Xeric Oak Forest; Woodland, Savanna	0	320	1,030	4,350	3,100	8,800
Xeric Pine & Pine-oak Forest & Woodland	0	0	140	2,480	880	3,500
Dry and Dry-mesic Oak-pine Forest	0	320	1,570	8,930	1,280	12,100
Montane Spruce-fir Forest	0	0	160	20	20	200
Non-Forest	1,100	0	0	0	0	1,100
TOTALS	1,100	3,840	14,830	43,580	9,950	73,300

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riparian areas would be intentionally set back in succession to create habitat for early seral riparian species. Overall, trends are expected to create a distribution of both early and late successional riparian forest on national forest land that is roughly similar to the conditions that supported associated species prior to European settlement (but see below for consideration of cumulative effects including condition of private lands). Patches of created early successional habitat are not expected to diminish the role of riparian areas as landscape corridors because of their small size and relative rarity, and their occurrence within a predominately mature forest matrix. Since riparian areas are treated the same in all alternatives, Table 3-54 and Table 3-55 do not vary by alternative.

Table 3-55. Expected percent of total riparian corridor acreage in each forest successional stage following 50 years of implementing forest plan revision alternatives

Forest Community Type	Successional Stage (All Alternatives)					
	Early	Sap/Pole	Mid	Late	Old	Total
Northern Hardwood Forest	0	0	20	90	1,390	1,500
Conifer-Northern Hardwood Forest	0	0	520	400	2,580	3,500
Mixed Mesophytic Forest	0	0	1,000	5,070	11,430	17,500
River Floodplain/E. Riverfront Forest	0	0	0	70	30	100
Dry-Mesic Oak Forest	0	0	1,660	11,180	12,160	25,000
Dry & Xeric Oak Forest; Woodland, Savanna	0	0	320	230	8,250	8,800
Xeric Pine & Pine-oak Forest & Woodland	0	0	0	140	3,360	3,500
Dry and Dry-mesic Oak-pine Forest	0	0	320	1,570	10,210	12,100
Montane Spruce-fir Forest	0	0	0	130	70	200
Non-Forest	1,100	0	0	0	0	1,100
TOTALS	1,100	0	3,840	18,880	49,480	73,300

For the Acadian flycatcher, the direct and indirect effect of all alternatives would be positive. Analysis indicates that, under all alternatives, in 50 years the riparian corridors would move toward the desired condition for the Acadian flycatcher, i.e. mature to older-aged forests. Acadian flycatcher populations are expected to increase as the riparian forest matures due to the close association between this species and this habitat type. Breeding densities in suitable habitat average 14.5 pairs per 100 acres, with high densities reaching 43 pairs per 100 acres (Hamel 1990: C-5). Table 3-56 displays the expected effects of each alternative on Acadian flycatcher populations.

Table 3-56. Expected population trend[1] of Acadian flycatchers under forest plan revision alternatives 10 and 50 years following plan adoption. Population trend estimates are based on expected trends in habitat quantity and quality.

Time Period	Alternative						
	A	B	D	E	F	G	I
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.

Cumulative Effects

Cumulatively, networks of riparian corridors across the national forest landscape have been fragmented by mixed ownerships and land use conversion. This condition is expected to persist across all alternatives. Alteration of riparian areas from conditions needed to support dependant species is most prevalent along larger rivers and streams, which are disproportionately under private ownership. Historically these sites likely provided the best quality habitat for riparian-dependant species, and an especially large proportion of the landscape's early successional riparian component, due to their use for Native American agriculture. These sites still are most likely to provide large areas of early successional riparian habitat due to private land management actions, but habitat quality cannot be assumed. Many riparian areas are in land uses that are no longer suitable for either early- or late successional riparian species. Expected trends for riparian areas on national forest land—moving toward mature forest dominance with a small component maintained in early successional habitat—would contribute to sustaining associated species on the landscape. However, under all alternatives, abundance and distribution of both early- and late successional riparian habitats would be reduced in important ways relative to conditions that supported associated species prior to European settlement.

SNAGS, DENS, AND DOWNED WOOD

Large woody debris (including branches, large logs, stumps, and root wads) is an important habitat component both to streams and terrestrial areas. 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 (see section on Indiana bat). Amphibians, reptiles, small mammals, and invertebrates utilize woody debris as cover. Animals use snags, logs, and stumps as denning sites. Downed wood and logs are used for drumming by grouse to attract mates. Turtles and snakes use logs in streams and overhanging branches for basking and sunning. 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 influences 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 an important habitat component for many species. They are used for nesting, roosting and hibernating. Den tree characteristics typically occur in older aged trees as they are affected by various forest pathogens or injury from lightning and windstorms resulting in rotten heartwood.

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 2-4 snags per acre being a "reasonable target." Generally, for most dependent wildlife, the more snags the better for associated species.

BIOLOGICAL ENVIRONMENT

TERRESTRIAL SPECIES AND THEIR HABITATS

SNAGS, DENS, AND DOWNED WOOD

Snags are important to bats, including the Indiana bat, for roosting by males and females during the summer. Female bats form small maternity colonies under loose bark or in cavities of snags, as well as mature live trees in riparian or upland forests. There are no known Indiana bat maternity colonies on the Jefferson National Forest or in the State of Virginia.

Snags, downed wood, and den trees are typically most abundant in late successional forests. Current abundance of late successional forest by community type is shown under the section on Successional Forests. This information indicates late successional forests are abundant on the forest. Snags and downed wood also may be extremely abundant in forests affected by mortality events such as storms and insect and disease outbreaks. Many species of potential viability concern are associated with snags, downed wood, or den trees (Appendix E).

On the Jefferson National Forest there are approximately 17.5 snags per acre across the forest. This information was gathered from 129 Forest Inventory Analysis (FIA, USDA Forest Service 1991) plots done on the Jefferson National Forest. Included here as snags are those coded “rotten culls” (2 per acre with an average diameter of 17 inches) and “dead” (15.5 per acre with an average diameter of 9 inches in the FIA plot data).

MANAGEMENT INDICATORS

Acres of late successional forest is an appropriate indicator of the effects of management on these habitat elements because their relative abundance in this successional stage. The pileated woodpecker (*Drycopus pileatus*) is the best management indicator species (MIS) for snags, dens, and downed wood. It requires large cavity trees for nesting and forages on dead trees and downed logs across a variety of community types (Hamel 1992:190). Populations of this species are tracked by the annual Breeding Bird Surveys (BBS) and bird point counts conducted throughout the Southeast.

Direct and Indirect Effects

Forest-wide direction for potential black bear den trees under all alternatives states that den trees would be left during all vegetation management treatments. Potential den trees are greater than 20 inches DBH. Potential den trees also include those that are hollow with broken tops or those with limbs greater than 12 inches diameter broken near the bole of the tree.

Direction within Management Prescription 8E1 (early successional habitat for ruffed grouse) states that at least 1 large, greater than 12 inch diameter, downed tree would be left per acre during management activities to be a potential drumming log (see discussion of ruffed grouse in the Demand Species section).

Direct impacts to the Indiana bat may result in direct mortality or injury to roosting bats when intentional felling of undetected roosts, or accidental felling of occupied snags or damaged or hollow trees occurs during fuelwood gathering, timber harvest, or site preparation. The likelihood of cutting a tree containing a maternity colony or individual roosting Indiana bat is anticipated to be extremely low because of the large number of suitable roost trees present on the Jefferson National Forest, the low level of management activities across the Forest that could result in the cutting of snags, the rarity of the species, and the wide dispersal of Indiana bats and maternity colonies throughout the species' range. Additionally, and most importantly, there are no known maternity colonies on the Jefferson National Forest or in the State of Virginia. Forest-wide direction for snags follows the Indiana Bat guidance of leaving a minimum of 6 snags or cavity trees (9 inch diameter or larger) per acre, unless they are a safety hazard for clearcuts 10 to 25 acres in size. Group selection openings and clearcuts less than 10 acres have no provision for retention of a minimum number of snags, cavity trees, and residual basal area. All other harvesting methods (and clearcut openings 26-40 acres in size) will retain a minimum residual 15 square feet of basal area per acre (including 56 snags or cavity trees) scattered or clumped.

Riparian Corridor direction for large woody debris (LWD) in streams includes the objective to restore and maintain approximately 200 pieces of LWD per stream mile to maintain habitat diversity for aquatic-dependant species. LWD is a piece of wood within the stream channel that is at least 4 inches in diameter and 4 feet long.

The above direction for Indiana bat and riparian corridors will not vary by alternative or prescription.

With these provisions included under all alternatives, existing snags, downed wood, and den trees would be well maintained on national forest land. Fire may reduce snags and downed wood in fire-dependant communities, but can also cause some tree mortality creating new snags and downed wood. Reduced density of these habitat elements in fire-dependant communities is expected to be within the range of variability that typically occurred in these communities under historical fire regimes.

Recruitment of new snags, downed wood, and den trees is most dependent on providing abundant late successional forests. Expected percentages of late successional forests are presented under the section on Successional Forests. This analysis indicates that within 10 years following plan implementation, all alternatives will contain at least 71% of the forested acres in late to old successional stages. After 50 years of plan implementation, the forested acres in late to old successional stages range from 69% in Alternative D to 92% in Alternative G.

With the above protection and management provisions and the continuous creation of more habitat through aging age-class distributions, all alternatives will result in an increasing abundance and improved distribution of these habitat elements over the next 50 years, with benefits to associated species. Increased mortality of trees due to forest health threats potentially would increase abundance of snags and downed wood regardless of management approaches (see cumulative effects discussion below). Although den trees are also expected to increase in abundance as forests age, restoring an abundance of very large diameter den trees will require longer than 50 years of forest growth in many forest community types.

Because of their dependence on large snags, pileated woodpecker populations are expected to follow trends in snag availability and the abundance of older forests. Population trends, therefore, should be positive under most alternatives over the long-term. Table 3-57 displays expected effects of each alternative on pileated woodpecker

Table 3-57. Expected population trend[1] of pileated woodpeckers under forest plan revision alternatives 10 and 50 years following plan adoption. Population trend estimates are based on expected trends in habitat quantity and quality.

	Alternative						
Time Period	**A**	**B**	**D**	**E**	**F**	**G**	**I**
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.

populations.

However, because pileated woodpeckers breed at relatively low densities (2.1 pairs per 100 acres on average, Hamel 1990:C-4), obtaining robust datasets on populations is difficult. Therefore, to examine national forest trends in abundance of this species, data will likely need to be pooled with that from other national forests within the ecoregion and evaluated by comparing national forest trends with overall regional and range-wide trends.

Cumulative Effects

Across landscapes containing the national forest, national forest system lands are expected to provide a disproportionately large share of the best quality habitats for species associated with snags, downed wood, and den trees. This result is expected because of the dissimilar distribution of older forests between national forest and private lands (see section on Successional Forests). This disparity is expected to increase over time as other land uses affect abundance of older forests on private lands. Forest health threats also are expected to substantially add to cumulative effects on these habitat elements, by increasing tree mortality. The increasing number of threats and increasing severity of effects has created an abundance of snags and downed wood at many locations on the national forest. This trend is expected to continue into the foreseeable future as forests age and many threats expand their zone of influence (see section on Forest Health). While national forest management can reduce the severity of tree mortality in some locations, forest health threats are nevertheless expected to have a substantially positive effect on abundance and distribution of snags and downed wood under all alternatives. Den trees, which generally need longevity to become high quality habitat elements for wildlife, are likely to be negatively affected by gypsy moth by killing trees before they grow large across all alternatives.

DEMAND SPECIES

White-Tailed Deer

White-tailed deer use a variety of forest types and successional stages to meet their year-round needs. In the Southern Appalachians, clearcuts and older forests provide complementary benefits to deer (Johnson et al. 1995). Older forests generally are most important in the fall and winter. When available, acorns are the dominant fall and winter food item (Wentworth et al. 1990a). When acorns are scarce, the bulk of the diet consists of leaves of broadleaf evergreen shrubs, primarily rhododendron (*Rhododendron maximum).* 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, 1992). Use of clearcuts was very low in winter (Wentworth et al. 1990b). However in the spring and summer, clearcuts provide an abundance of food and are heavily utilized (Wentworth et al. 1990b, Ford et al. 1993). Young regenerating stands contain substantial quantities of woody browse, herbs, fungi, and soft mast, all of which are limited in older forests (Johnson et al. 1995). 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 when acorns are in short supply (Wentworth et al. 1990b).

In eastern hardwood forests, Barber (1984) recommended that at least 50% of the acreage should consist of mature mast trees with the remainder containing an interspersion of evergreens, shrubs and vines, and openings with herbaceous and young-growth woody vegetation. Based on utilization data, current deer densities in the Southern Appalachians can be maintained by providing approximately 5% in regenerating stands

(Wentworth et al. 1990b). Wentworth et al. (1989) concluded that approximately 2% of the area in high quality wildlife openings would be necessary to adequately buffer the effects of a poor acorn year.

White-tailed deer are present throughout the Region. Population densities generally are medium to high in the Northern Ridge and Valley, Allegheny Mountains, Northern Cumberland Mountains, and Southern Appalachian Piedmont Sections, and low to medium in the remainder of the SAA area (SAMAB 1996). High population densities are associated with greater amounts of cropland and lesser amounts of developed and coniferous forestland. Current deer densities are generally higher on private lands than on national forest and state lands in Virginia.

FOREST TRENDS

The Jefferson National Forest is comprised of lands in nineteen Virginia counties, one West Virginia County, and two Kentucky Counties. Approximately 97% of this land is located in Virginia, more than 2% in West Virginia and less than 1% in Kentucky. Kentucky data was not looked at in depth because of the few acres of national forest system lands involved. There are approximately 355,000 hunters in Virginia with about 250,000 hunting deer (VDGIF Publication 99-1). Recreation generated primarily by deer hunting produced approximately $221 million in 2001 in the state (2001 USFWS Survey). Some 323,000 people hunt deer in West Virginia with the sport generating approximately $247.5 million annually to the states' overall economy (USFWS 1996).

Game harvest regulations and habitat improvement techniques (such as forest treatments, prescribed burning, and wildlife opening development and maintenance) have helped create healthy deer populations throughout these states. Deer population densities for public lands in Virginia counties is highly variable ranging from approximately 10 to 50 deer per square mile with an average across the area of approximately 39 per sq. mi. (Knox, VDGIF data, 2002). The deer population for Monroe County on the Jefferson NF in West Virginia averages about 40 deer per square mile (Glasscock 2002). Deer densities are normally greater in areas of high quality, available browse, hard mast production of both red and white oaks, and well distributed, high quality wildlife openings. These conditions are most influenced by soil fertility and are more common where there is an intermingling ownership of private and National Forest System lands. Most deer herds have experienced exponential growth over the past decades. Deer densities are managed by controlling the number of antlerless deer hunting days. Liberalized hunting regulations over several years appear to have stabilized the herd growth for most areas in Virginia. Currently, most of Virginia's deer herds are managed at moderate to low population densities (VDGIF Publication 99-1 and state harvest data of antlered bucks was used to derive deer population estimates).

The deer management objective for the Virginia Department of Game and Inland Fisheries is based on the Cultural Carrying Capacity (CCC) and is intended to stabilize the deer population over most of the nineteen counties of the Jefferson National Forest. An increase in the deer population is desirable for public and private lands in Wise County and all Jefferson National Forest System lands in the counties of Carroll, Grayson, Lee, Scott, Smyth, Tazewell, and Washington (VDGIF Publication 99-1). The deer population trend for Monroe County in West Virginia has been increasing but recent liberalization of the antlerless harvest should reflect a desired leveling off in future years (Glasscock 2002).

The quality of deer habitat has declined in recent years on National Forest System lands in many western Virginia counties because of maturing habitat conditions with little replacement of early successional edge habitat for browse. This has been attributed to the reduction in timber harvest over the past 20 years resulting from national public opinion and various budget restrictions within the Forest Service. The Virginia Department of Game & Inland Fisheries (VDGIF) recommends implementation of habitat management improvements that are beneficial to deer over 1% of the total National Forest acreage annually (VDGIF Publication 99-1).

Table 3-58 reflects the desired condition and current situation for deer regarding early successional, mid–late successional mast producing, and permanent opening habitats across the Jefferson NF. Early successional acres include those found across all community types. The acreages of mid thru late successional habitats include only those community types (5,21,22,25) that have the potential to provide a significant amount of hard mast. Permanent openings include areas especially for wildlife that receive annual or very frequent maintenance, old-field habitats, utility rights of ways, pastoral areas, and open grass balds.

Table 3-58. Desired and current conditions for deer (2002) by habitat type on the Jefferson National Forest

Habitat Component	Desired Condition	Current Acres	% Total Acres
Early successional (0-10 yrs.)	5 – 10 %	8,372	1%
Mid – late successional (mast)	>50%	565,886	78%
Permanent openings	2%	11,810	1.6%

Direct and Indirect Effects

Deer habitat quality and numbers are directly associated with soil quality, habitat type, successional stage, and the amount of habitat interspersion or edge (VDGIF Publication 99-1). The Forest Service recognizes that deer numbers are generally higher and increase from the implementation of projects that increase food production such as the cutting of trees, prescribed burning and the development and management of food plots. Conversely, deer populations are usually lower and decline over time from actions that limit the development of early successional habitat and allow the forest to mature, such as the designation of areas with preservation management strategies. The importance of a diversity of hard mast producers, early successional habitat for browse, and permanent openings, with each being well distributed across the landscape to meet the year-round needs of deer have been previously discussed. The effects of each alternative on these key habitat features is discussed in detail in previous sections (See Successional Forests and Permanent Openings). Table 3-42 and Table 3-49 quantify these major habitat components by alternative over a ten year and fifty year period.

Table 3-58 of the DEIS provides the desired conditions for early successional habitat (5-10 %), the current acreage on the Jefferson National Forest within this age class (8,372 acres) and the current percentage of the total Forest acreage within this age class (1%). Table 3-42 of the DEIS depicts the percentages of early successional forest at 10 years and 50 years of forest plan implementation under each alternative. The highest percentage of forested acres in early successional conditions is 4.4% at 10 years under Alternative D. Management under any alternative within this plan provides only minimal increases in deer habitat (thus deer numbers) within specific areas of the forest that are actively managed.

Most early successional habitat would be developed in 8A1 management prescription areas that comprise only 6% of the total forest acreage. Management prescription area 8A1 lands are relatively well distributed over some JNF units while they are clumped or situated along the periphery of others. This makes it difficult to meet the deer habitat requirements for early successional habitat within the interior of some units. It could adversely affect the recruitment of deer and cause herd reductions over time within these units where this habitat is poorly distributed. Ownership patterns and adjacent private lands can offset or compound distribution problems in at least two ways: (1) Early successional habitat may be provided on adjacent private lands that will meet browse needs for deer within localized areas; or (2) The deer may move off NF lands where browse is insufficient and cause damage to crops and pastures, thus becoming a nuisance to private landowners. Such movements may result in private landowner requests for kill permits, restitution from hunters through county damage stamps, or the filing of insurance claims for deer damages to their property. In either case, the opportunity for hunting recreation is diminished because hunting by the general public is not allowed on most private lands and the overall numbers of available deer are decreased on NF lands.

Tree harvest is also appropriate under some other management prescriptions for the improvement of wildlife habitat. The majority of early successional habitat would be provided through either shelterwood or clearcut harvesting methods. Additional deer forage would also be provided through other vegetation manipulations such as the thinning, group selection and prescribed burning of selected areas. These actions not only stimulate browse production but also increase soft mast production from species such as grape, crabapple and black cherry that are important seasonal foods for deer. The use of prescribed fire will be relied upon heavily to provide a good distribution of browse rejuvenation necessary to maintain quality forage for deer and high quality hunting opportunities for forest visitors.

Hard mast producing species are generally well distributed across the Jefferson NF although their success is heavily dependent on weather conditions during flowering. Adequate mast crops occur about every 3 to 5 years with heavy crops occurring about every 5 to 8 years. The availability of hard mast is not considered to be a problem with any plan alternative as shown in Table 3-58.

Although the acreages of some type of permanent opening for deer appear sufficient to sustain populations during mast failures, the distribution of this habitat type across the forest is less than desirable in many cases. Some areas of the forest have very few permanent openings due to terrain, access, soil conditions, or management prescriptions.

The Forest Service also recognizes that both plant and animal populations can be adversely affected from the overpopulation of deer within an area. Some plants of the families Liliaceae and Orchidaceae are preferred as browse for deer. Deer populations commonly increase and exceed the biological carrying capacity (overpopulation) of the area where development of early successional habitat for food and hunting are not allowed. “Virginia does not currently have many significant widespread “overpopulated” deer herds and most of Virginia’s deer herds are managed through hunting at moderate to low population densities, in fair to good physical condition, and below the biological carrying capacity” (VDGIF Publication 99-1). National Forest System lands receive annual hunting to control deer densities. Thus the hunting of National Forest System lands and the allowance for more liberal taking of deer in Virginia will prevent over-population of these areas and thus prevent the depletion of plant diversity and protect the viability of herbaceous ground flora in these areas.

Cumulative Effects

The previous table indicates the relative amounts of early successional habitat for browse, mid-late successional forest for mast production, and permanent openings expected over a fifty-year period from implementation of various alternatives of the Forest Plan. The amount of early successional habitat declines further below the desired amounts over the 50-year period for all alternatives, but especially with alternatives E and G. The amount of mid-late successional forest remains stable or reduced only slightly from the ten-year figures and is well above the 50% recommended previously for each alternative. Acreages of permanent openings are expected to remain relatively constant over the next 50 years for all alternatives except alternative B and G where the acreages for balds and pastoral areas would be reduced by 50% and 100% respectively.

Long-term declines in deer populations are expected under management alternatives A, B, D, F and I with significant declines under alternatives E and G. The quality of deer hunting opportunities is expected to decline over the long-term.

Eastern Wild Turkey

Wild turkey occupies a wide range of habitats, with diversified habitats providing optimum conditions (Schroeder 1985). This includes mature mast-producing stands during fall and winter, shrub dominated stands for nesting, and herb dominated communities, including agricultural clearings for brood rearing. Habitat conditions for wild turkey can be enhanced by management 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).

For the eastern hardwood region, Wunz and Pack (1992) recommended maintaining 50 to 75% of the area in mast producing condition and approximately 10% in widely distributed permanent herbaceous openings in addition to the temporary openings that result from timber harvest and other activities. They suggest that clearcuts should be 30 acres in size or less. Light thinning (removing less than 20% of basal area) is recommended to enhance the herbaceous component of the stands. Heavier thinnings that increase the quantity of woody species is less desirable. Prescribed burning in conjunction with thinning in oak forests can be used to enhance brood habitat. Other important habitat components include spring seeps, especially in areas with regular snow cover, and a diversity of soft mast producing plants (e.g. dogwood, black gum, grape, blueberries, etc).

For the southern pine region, Hurst and Dickson (1992) recommended that at least 15% of the area should be kept in mature hardwoods such as streamside zones or pine-hardwood corridors. Forest openings and soft mast species also are important habitat components. Pine plantations should be thinned frequently and burned on a 3-to-5 year rotation to enhance herbaceous vegetation and soft mast production.

Eastern wild turkeys are present throughout the Region. Population densities generally are medium to high in the Northern Ridge and Valley, Allegheny Mountains, Northern Cumberland Mountains, and Southern Appalachian Piedmont Sections, and low to medium in the remainder of the SAA area (SAMAB 1996). High population densities are associated with greater amounts of oak forest and cropland, and lesser amounts of developed and coniferous forestland. Wild turkey populations have expanded in range and density in the last 25 years. As with deer, this increase likely is related to both nonhabitat factors such as extensive restoration efforts, protection, and conservative harvest strategies as well as increased acorn capability resulting from the increase in mid-to late successional oak forests.

FOREST TRENDS

Current density estimates for Jefferson NF lands in Virginia are 1—7 turkeys per square mile, with an average of about 4 turkeys per square mile across the forest. Analysis of the spring turkey harvest data for the Jefferson NF in 2002 indicates a total population of about 6,500 birds. The population of turkeys within the counties of Carroll, Craig, Dickenson, Giles, Montgomery, Pulaski, Roanoke, Rockbridge and Scott appear to be increasing. Populations in Bedford, Bland, Botetourt, Grayson, Lee, Smyth, Tazewell, Wise and Wythe Counties appear stable. Washington is the only county where the turkey population appears to be declining (Norman, 2002). The turkey population for Jefferson NF lands in Monroe County, West Virginia is similar to that of Giles County, Virginia and averages about 4 turkeys per square mile and is increasing.

Table 3-59 reflects the current situation and desired condition of early successional, mid–late successional mast producing, and permanent opening habitats for turkey across the Jefferson NF. Early successional acres include those found across all community types. The acreages of mid thru late successional habitats include only those community types (5,21,22,25) that have the potential to provide a significant amount of hard mast. The acreage of permanent openings include areas that receive annual or very frequent maintenance, old field habitats, utility rights of way, pastoral areas, and balds.

Table 3-59. Desired and current conditions for turkey (2002) on the Jefferson National Forest

Habitat Component	Desired Condition	Current Acres	% Total Acres
Early successional (0-10 yrs.)	3 – 10 %	8,372	1%
Mid – late successional forest	50 – 75%	565,886	78%
Permanent openings	10%	11,810	1.60%

Direct and Indirect Effects

Wild turkeys require a mixture of various successional stage habitats to meet their year-round habitat needs, as previously mentioned. Key requirements include the interspersion of mature mast producing stands during fall and winter, shrub dominated stands for nesting (early successional habitat), and herb dominated communities, including permanent openings for brood range. The effects of each alternative on these key habitat features is discussed in detail in other sections of the plan. Disturbance may also be a concern during the nesting season in areas that are heavily used by forest visitors. Table 3-42 and Table 3-49 quantify these major habitat components by alternative over a ten year and fifty year period.

Alternatives A, D, and F minimally meet the requirements for turkeys for early successional (shrub) habitats used for nesting over the 10 year period. All other alternatives fall below the percentages of this type habitat considered desirable for this species. The distribution of early successional habitat is also problematic for turkeys on some units. (See discussion on distribution of the 8A1 management prescription under White-tailed deer).

All alternatives fully meet the desired levels of mast production in total acreage. Distribution of this habitat should not be a problem considering the Oak and Oak-Pine Forest type covers more than 90% of the forested acres on the JNF.

The availability of permanent clearings for brood range is the most limiting factor to turkey populations on the Jefferson. Both the total acres and distribution of this habitat are problematic. These problems cannot be solved completely within this plan period because of the large deficit and locations of this habitat type across the forest. Alternative I meets these needs better than other alternatives, but falls very short of the 10% of the total acres that is desirable for turkeys. Many of the existing areas of permanent openings presently occur as large pastures or close clusters of wildlife openings that receive little use by turkey broods. Brood habitat may be provided on adjacent private lands, but this is dependent upon landownership patterns and the vegetational coverage of these lands. Poaching has been identified as a serious threat to turkey management within and around the Jefferson NF. Turkeys tend to move off large unbroken tracts of mid to late successional forest to areas where brood habitat, in the form of permanent clearings, is available. When turkeys move out of the protection of forest cover and onto large open grasslands, such as private pastures, they become more vulnerable to poaching. This problem is increased where open public roads are located nearby.

A combination of vegetation manipulation practices in the form of timber harvest, prescribed burning, and some new clearing development must be implemented in a variety of forest plan prescriptions to more fully meet the needs of turkeys on the forest. The increased use of prescribed fire will open up the understory, improve the sight distance for turkeys, stimulate the growth of legumes and other plants turkeys use for food, and maintain natural grassy savannahs that are also used as brood habitat. Prescribed fires result in a mosaic of conditions ranging from very light burn conditions to small, isolated areas of heavy scorch. These small areas of scorch cause tree mortality and open up the canopy to allow sunlight to reach the forest floor and results in dense shrub growth that is used for nesting.

Cumulative Effects

A small portion of the deficit in early successional habitat would be met through other uneven-aged harvesting techniques, natural occurrences such as wildland fire, wind and ice, and insects. It is likely that this habitat condition would still fall very short of the 3-10% considered desirable. The amount of mid-late successional, mast producing forest is reduced only slightly over the 50-year period but remains well above the 50-75% recommended levels. Acreages of permanent openings fall very short of the desired levels of 10% but actually increase slightly under Alternative I. Alternatives B and G show declines in acres of permanent openings below current levels. A small portion of this deficit should be made up through temporary openings created by tree harvesting actions and prescribed burning. It is unlikely that many new permanent openings will be constructed due to their high costs of construction and maintenance. Therefore, maintenance and perpetuation of permanent openings is very important.

Overall turkey populations are expected to remain at about current levels over the next 50 years under management alternatives A, D, E, and F. Alternative I may show very slight localized increases. Other alternatives are expected to result in decreases in turkey numbers. Turkey populations would be expected to be highest where all three major habitats exist in desirable proportions and lowest where they do not. The quality of turkey hunting is expected to remain good, although hunters may have to disperse to other areas of the forest where more active habitat management is occurring. Turkey hunters are increasing nationally. Such increases in hunters without subsequent, well distributed, increases or stability in turkey population causes overcrowding and serves to downgrade the sport.

Ruffed Grouse

Ruffed grouse utilize a variety of forest habitats and successional stages. Nesting cover generally is located in poletimber or larger hardwood stands (Harris 1981, Thompson and Dessecker 1997). Haney (1996) also reported use of old growth cove hardwood forests in the Southern Appalachians for nesting and brood rearing. While nesting habitat does not appear to be limiting, close interspersion with secure adult cover and brood habitat is important (Thompson and Dessecker 1997).

Some key features of brood cover are security and an abundant high protein food source. Insects are most abundant in habitats characterized by lush herbaceous vegetation (Dimmick et al. 1996). Thompson and Dessecker (1997) describe brood cover as 3-7 year-old regenerating stands containing significant herbaceous component through shrub dominated old fields and herbaceous openings. In Georgia, broods preferred upland hardwood sapling (>10 year-old) and poletimber habitats, but also used sawtimber stands, although not in proportion to availability (Harris 1981). Regeneration areas (<6 years-old) and evergreen shrub thickets were avoided. Brood habitats were characterized by dense and diverse, herbaceous vegetation which provided low overhead cover with freedom of movement beneath. Dimmick et al. (1996) suggest that the lack of interspersion of areas with a well developed herb layer and areas of high stem density for protective cover may be one of the limiting factors in southeastern grouse populations. They suggest that brood habitat could be enhanced by the conversion of logging roads and log landings to linear food plots by planting clover/grass mixtures, which would provide bugging areas in close proximity to secure cover.

Adult cover, including drumming habitat, usually consists of young regenerating forest (6-15 year-old) or shrub cover (Thompson and Dessecker 1997). The dense cover provides protection from both avian and mammalian predators. Secure cover is provided in habitats with good vertical structure (8,000+ stems/acre) of 15-20 foot saplings (Kubisiak 1989). Dimmick et al. (1996) reported that males began to orient their drumming sites around or in clearcuts within 3 years post harvest. In Georgia, drumming habitat was associated with the presence of a relatively dense understory of heath shrubs; primarily flame azalea and mountain laurel (Hale et al. 1982). No strong preference for timber types or stand condition classes was evident. Harris (1981) found that males preferred upland hardwood sawtimber, generally associated with evergreen shrub thickets during the breeding and post breeding seasons.

Dimmick and others (1996) found that breeding male density (based on drumming counts) increased significantly in response to clearcutting in Tennessee. A similar response to timber harvest was reported from oak-dominated forests in Missouri (Wiggers et al. 1992). Highest grouse densities occurred where 7-to-15 year-old hardwood regeneration comprised greater than 14% of the area.

In oak forests of the Central Hardwood region, Thompson and Dessecker (1997) recommended managing on an 80-year rotation that would maintain approximately 15% of the forest in brood or adult cover (3-15 years old). Appropriate regeneration methods include clearcut, seedtree, and shelterwood. Residual basal areas should not exceed 20 square feet per acre. Cutting units should be > 5 acres, and preferably 10-40 acres in size. Group selection is not recommended since the regeneration patches are too small to provide large enough patches of contiguous habitat. In Missouri, Kurzejeski and others (1987) also recommended managing oaks on an 80-year rotation, but suggested harvest units should be less than 20 acres in size. In another study in Missouri oak forests, Wiggers et al. (1992) recommended maintaining more than 14% in 7-to-15 year-old hardwood regeneration. Kubisiak (1985) recommended the use of shelterwood cuts or clearcuts of 20 acres or less, leaving designated groups or scattered oaks (residual basal area less than 20 square feet per acre) with potential as mast-bearers or den trees. Larger cuts up to 40 acres are acceptable if in linear strips.

Dominant fall and winter foods in the Southern Appalachians include leaves and fruits of greenbrier (*Smilax* spp.), the leaves of mountain laurel (*Kalmia latifolia*), fruits of grapes (*Vitis* spp.) and oaks (*Quercus* spp.), and Christmas fern (*Polystichum acrostichoides*) (Seehorn and others 1981). Similarly, Stafford and Dimmick (1978) reported that greenbrier, mountain laurel, and Christmas fern were the dominant fall and winter food items in the Southern Appalachian region of Tennessee and North Carolina. When available, acorns comprise a significant proportion of the diet (Seehorn et al. 1981, Servello and Kirkpatrick 1987, Kirkpatrick 1989, Thompson and Dessecker 1997). They provide a high energy food source during the critical winter period when forage quality is limited (Servello and Kirkpatrick 1987, Kirkpatrick 1989). However, lack of secure cover in open oak stands may limit their use by grouse (Stafford 1989, Thompson and Dessecker 1997). Kubisiak (1985) suggested that 40-60% of a compartment be maintained in stands of mast-bearing age.

Ruffed grouse are found primarily in the Northern Ridge and Valley, Allegheny Mountains, Northern Cumberland Mountains, Blue Ridge Mountains, Northern Cumberland Plateau, and Southern Cumberland Mountains (SAA Terrestrial Report, pgs. 66-67). Low density populations also extend into the adjacent portions of the Central Ridge and Valley, Southern Cumberland Plateau, Southern Ridge and Valley, and Southern Appalachian Piedmont. Population densities generally are moderate in the Blue Ridge Mountains and low to moderate elsewhere. Current grouse densities generally are higher on national forest system lands, national parks, and the Cherokee Indian Reservation than on other ownerships. However, grouse population densities have declined over the last 25 years. The declining trend likely is largely due to the reduction of forest cover in the sapling-pole successional class, which is important to this species.

Areas of quality grouse hunting are in very short supply today and do not meet hunter demands because of very limited habitats where they exist. Ruffed grouse populations on the Jefferson NF appear to have declined over the last two decades as they have throughout the Southern Appalachians. Much of this decline is attributable to reduced availability of hardwood shrub-sapling habitat due to reductions in timber harvest levels. Recent habitat trends have moved more toward mid to late successional forests with more than 87% of the forest exceeding 60 years of age and only 3% less than 20 years of age. Optimum habitat conditions consist of a variety of habitats and successional stages including 40-60% in mid-late successional forest for mast production and nesting, approximately 15% in (6-15 year old) even-age deciduous stands capable of producing 20-25,000 woody stems per hectare (Gullion 1984a; Kubisiak 1985; Stoll et al. 1999; Dimmick et al. 1998, Dessecker 2001) and shrub dominated old field habitats. Permanent openings are normally either too large, too open, or do not have thick escape cover nearby to be considered optimum for grouse use. Mortality from avian and mammalian predators is a significant factor limiting grouse populations in the Southern Appalachians (Reynolds et al. 2000).

Direct and Indirect Effects

Although ruffed grouse use a variety of forest habitats and successional stages, population responses are most strongly tied to the availability of early successional habitat, particularly hardwood shrub-sapling habitat. Some of the mountain forests have utilized specific management prescription allocations to create ruffed grouse management areas. This management prescription (8E1) was developed to provide conditions favorable for grouse including a relatively high proportion of early successional habitat (10-17%) and suitable habitat structure. The following prescription level standards are in place for the 8E1 management prescription on the Jefferson NF:

- “To achieve the structural habitat conditions for ruffed grouse, < 20 sq. ft./acre residual basal area is retained in even-aged regeneration units, with oaks of mast producing size favored as residuals.”
- “Harvest unit size should range from 5 to 20 acres in size.”
- “Permanent openings should be linear and managed as shrub dominated old field habitats with adjacent thick escape cover.”
- “Provide suitable drumming logs at the rate of 1 per acre.”

Alternatives I, A, and E provide the best opportunity to improve habitat conditions for ruffed grouse, but vary by alternative. Alternative A is aimed at benefiting the local economies and providing habitat for demand species such as grouse but would sometimes choose management prescription 10B (timber production) over grouse if the site index is high. With Alternative E, emphasis is placed on a diversity of successional habitats and species with demanding habitat requirements but may choose a different management prescription based on scenic considerations and also cause habitat distributional problems. Alternative F is considered the No Action alternative. Grouse management would continue as under the old Forest Plan. Alternatives D would choose management prescriptions 10A or 10B over grouse and would provide some habitat, but lacks special management areas for grouse. Alternative G is the restoration alternative and no grouse habitat would be provided.

Table 3-60 shows the acres allocated to the ruffed grouse management prescription by Alternative. The acres allocated to the 8E1 management prescription varies among alternatives.

Table 3-60. Acres allocated to the Ruffed Grouse Habitat Management Prescription (8E1) by Alternative

Alternative	Acres
A	12,644
B	11,556
D	3,563
E	12,455
F	4,900
G	0
I	16,137

Only a limited number of acres are specifically allocated to the 8E1 ruffed grouse management prescription. However, many other prescriptions will provide improved habitat conditions for grouse through the development of additional early successional habitat. Prescribed burning may also improve habitat for grouse on treated areas by stimulating a well developed herb layer, additional plants for grouse food, and creation of additional early successional habitats through introduction of disturbance into the forest. The effects of each alternative on the key habitat features are discussed in detail in previous sections (See Mix of Early and Late Successional Forests and High Elevation Early Successional Forest). Alternative I would best meet the demands for grouse and grouse hunters because of the amount of habitat created.

Cumulative Effects

Habitats that benefit grouse and many other early successional species are currently in short supply across the Southern Appalachian Ecoregion. Human influence from urban sprawl, abandonment of agricultural lands, total fire suppression, and selective harvesting techniques has aided the decline and distributional changes for this habitat across the area. Private landowners appear more reluctant today to create new early successional habitat through timber harvesting. The trend appears to be further declines for this habitat in the future. Much of the shrub dominated old field habitats are disappearing as succession runs its' course with little or no recruitment.

Current supplies of quality grouse hunting areas do not meet the present demands of grouse hunters. This demand is likely to remain stable or increase over the next 10 years. Grouse numbers should increase slightly on Jefferson NF lands in the vicinity of habitat improvements such as management prescription 8E1 lands. Other areas will likely remain low in numbers because these habitats will not meet the special requirements of grouse. Therefore, the slight increases in grouse numbers expected under this plan will not be sufficient to meet the demands of grouse hunters in the future.

Black Bear

The black bear (*Ursus americanus*) uses a wide variety of habitats in the southern Appalachians, occurring primarily on National Forests and National Parks of the Southern Blue Ridge, Northern Cumberland, and Allegheny Mountains and the Northern Ridge and Valley. These public lands in Virginia, West Virginia, North Carolina, Tennessee, and Georgia connect to form a forested landscape of over 6 million acres where bears are generally distributed at low to medium densities. The increase of older oak forests in this large block of habitat, along with increased protection and conservative hunter harvest, has allowed bear populations throughout the southeastern mountain region to moderately increase over the past 30 years. Bears generally are absent from the Cumberland Plateau, Southern Cumberland Mountains, Southern Ridge and Valley and Piedmont (SAMAB 1995:61).

In 2000, the Jefferson National Forest's black bear population was estimated at approximately 747 animals, according to the Virginia Department of Game and Inland Fisheries (USFS 2001). There are approximately 126,000 acres of semi-primitive non-motorized habitat on the Jefferson National Forest. The Forest provides quality habitat as does two adjoining VDGIF wildlife management areas.

In the Southern Appalachians, including the Jefferson National Forest, important habitat elements are habitat remoteness, habitat diversity, den site availability, and availability of hard mast.

Levels of human access within bear habitat determine the degree of negative effects on bears (Beringer 1986; Brody and Pelton 1989). Generally, high bear population densities are associated with areas of low open road density (SAMAB 1995:87). Low-traffic roads and trails are used by bears as travel ways and provide the benefit of additional edge and associated soft mast, whereas high traffic volumes have a negative impact (B. Fletcher, pers. comm.). Effects vary based the duration and time of year the road or trail is open for use and the number and type of recreation users present. Recreation trails (hiking, mountain biking, ATV, or horseback) can potentially provide similar disturbance.

Black bears are opportunistic omnivores and consume a variety of seasonal plant and animal foods including flowering plants, grasses, various roots and tubers, and especially soft mast (grapes, berries, apples, etc.). However, availability of hard mast (acorns and hickory nuts) is critical throughout the winter, and reproductive success is closely related to this habitat factor (Eiler 1981; Wathen 1983; Eiler et al. 1989). Total production of hard mast and production by individual trees can fluctuate from year to year due to climatic and other factors (Downs and McQuilkin 1944; Fowells 1965).

Under general southern Appalachian forest conditions, most oaks produce acorns from 40 years of age until death (150-200+ years), although production drops off in later years (USDA Forest Service 1990). Average annual white oak acorn production begins to decline when trees reach about 30 inches dbh (diameter at breast height) (Greenberg 1999; Johnson 1994), and northern red oak acorn production declines at about 30 inches (Greenberg 1994). Black and scarlet oaks are prolific producers at smaller size classes. Chestnut oaks production peaks at about 20 inches dbh and production remains relatively stable after that (Johnson 1994). Acorn production can be sustained over time by ensuring adequate regeneration of oaks, releasing super-canopy, highly productive white oaks and providing a wide variety of species and age classes of oaks across the landscape.

Since bears utilize nearly any abundant plant or animal food, they are likely to thrive when a diversity of forest age classes and food sources are available. Vegetation management can provide much of this diversity (Reagan 1990). Naturally occurring events such as ice storms, wildland fires, and hurricanes provide habitat diversity, but at random intervals and locations, making benefits sometimes limited and unreliable.

Bears den in a wide variety of sites including road culverts, abandoned buildings, and in vegetation (Carlock et al. 1983). Traditional dens are found on the ground in caves, rockfalls, or under the root mass of uprooted trees, and in hollow trees. Carlock et al. (1983) and M. Vaughan (pers. comm.) found that hollow trees are preferred dens. Brody (1984) found that ground dens are preferred in the North Carolina mountains. Preference may be related to availability and may be a learned behavior (Brody 1984).

Direct and Indirect Effects

Actions of the state game commissions, including regulation of hunter harvest and establishment of bear reserves or sanctuaries, are primary influences on bear population levels. However, National Forest management determines habitat features such as levels of public access, levels of vegetation diversity, and availability of mast and den trees.

Availability of potential den trees on the Jefferson National Forest is high in some areas and low in others. This condition is influenced by past harvest and severity and frequency of fire. Potential dens are trees greater than 20 inches dbh that are hollow with broken tops (Carlock et al. 1983). This standard applies across all alternatives. Within acres allocated to management prescription 8C (Black Bear Emphasis), a minimum 125-year rotation is prescribed to ensure a continuous supply of den trees. Alternatives A and B would provide the highest acreages of management prescription 8C; Alternative I and D provide for slightly less acres of this prescription, and all others alternatives would provide lower levels, with Alternative C providing no acreage to this prescription. Dens are addressed under Section 4.3, Snags, Dens, and Downed Wood. The old growth component of the forest is widely scattered but existent in most watersheds, and given the protection of all existing old growth, no shortage is forecasted under any alternative.

Due to the current healthy status of the Jefferson's forest-wide bear population (VDGIF 2000), the assumption is made that sustaining existing levels of habitat remoteness is acceptable. Alternatives G and I would provide highest total acres of remote habitats, and Alternative D would provide the least acres (Table 3-61).

Table 3-61. Acres of Remote Habitat by Alternative

Management Prescription		Alternative (thousands of acres)						
		A	B	D	E	F	G	I
1A	Existing Wilderness	57.8	57.8	57.8	57.8	57.8	57.8	57.8
1B	Recommended Wilderness	28.2	15.6	15.7	81.6	0.0	156.1	25.2
12C	Backcountry No Motorized Use	0.0	1.6	0.0	0.0	0.0	4.6	9.8
12B	Backcountry Administrative Motorized Use Only	54.7	65.7	16.5	40.6	54.8	4.1	91.3
12A	Limited Motorized Use	2.9	0.0	3.5	6.1	67.3	10.7	9.7
8C	Black Bear Limited Motorized Use	91.2	69.2	59.0	9.5	9.4	33.3	57.3
TOTAL ACRES		234.8	209.9	152.5	195.6	189.3	266.6	251.1
PERCENT OF FOREST		32%	29%	21%	27%	26%	37%	35%

Habitat diversity is addressed under the section on Successional Forests. There will not be a shortage of late successional habitat under any alternative over the next 50 years. Bears also utilize a variety of habitat types, and Alternatives A, D, and F provide for the greatest amount of early successional habitats over the next 10 years.

Hard mast issues are addressed in the section on Mesic Deciduous Forests and the section on Oak and Oak-Pine Forests. Examination of Table 3-23 found within the Oak and Oak-Pine Forests section indicates that regardless of alternative, 68-71% of the total forested acres will be comprised of oak types that are mid, late or 100+ years in age. Alternatives E and G provide for slightly more acreage in a mast producing condition over the next ten years, with Alternative D the least. However, no alternative is expected to result in a decline of hard mast producing communities.

Black bear populations are expected to remain viable across the Jefferson National Forest throughout implementation of each of the alternatives. Alternative D is likely to produce the least compatible habitat conditions for black bear due to provision of the lowest acreage of unroaded or remote habitat.

Cumulative Effects

The current status of Virginia's black bear population is one that is considered growing (VDGIF 2000). The overall regional forecast is for potential bear habitat to remain stable on public land, including the Jefferson National Forest. Decreases are expected on private lands due to continued loss of forested habitats and increased development (SAMAB 1995:87).

Northern Bobwhite

Northern bobwhite numbers have declined steadily throughout their range for over 40 years and quite likely for much longer. From 1980 to 1999, fall bobwhite populations declined 66% and projected trends indicate a further decline of approximately 54% over the next two decades (Dimmick et al. 2002).

A lack of nesting and brood-rearing cover is considered the major limiting factor over much of the range of the northern bobwhite. The loss of native warm season plant communities by planting non-native invasive grasses, planting dense pine forests, and intensive production of row crops is principally responsible for limiting bobwhite populations as well as those of other species such as loggerhead shrike, dickcissel, bobolink, Henslow's sparrow, Bachman's sparrow, and field sparrow. Managed warm season grasses with an adequate component of forbs provide good to excellent nesting and brood-rearing habitat. Southern pines can be managed to encourage development of habitat conditions favorable for northern bobwhite. Hardwood forests provide important winter habitats for bobwhite throughout much of its range. Hardwood savanna management provides habitat conditions that promote bobwhite productivity and survival.

Northern bobwhite has specific seasonal needs that vary throughout the year. This species favors abandoned fields and brushy areas such as wood margins, hedgerows, thickets and open woods (Hamel 1992). Summer nesting cover and summer brood habitat consisting of grassy areas (preferably bunch grasses) and weedy patches with exposed bare ground are needed to provide for the recruitment within a population. Winter food and winter cover of seed producing plants and shrubby thickets are needed to carry populations through the dormant season (Rosene 1985). Habitat conditions for bobwhite quail require disturbances from burning and mowing or discing on 2 to 3 year intervals.

Good northern bobwhite habitat requires adequate interspersion of food species and cover that is not too dense. Good habitat can support about one bird per acre (2.5/ha; Murray 1957). In a habitat improvement experiment in Florida, pine forests were cleared and subterranean clover (*Trifolium subterraneum*) was planted to encourage the establishment of arthropods, an important food for chicks (Ribbeck 1987). Areas that were sharecropped and burned during winter and spring at 2-year intervals produced more quail than areas planted with food patches or areas that were sharecropped but not burned (Ellis 1969).

Rosene (1969) 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.

Predators of adult northern bobwhite include hawks and eagles (*Accipitridae*), falcons (*Falconidae*), foxes (*Vulpes, Urocyon*), bobcat (*Lynx rufus*), and domestic cats (*Felis sylvestris*) and dogs (*Canis domesticus*). Predators of chicks and eggs include weasels and skunks (Mustelidae), raccoons (*Procyon lotor*), Virginia opossum (*Didelphis virginiana*), snakes (*Coluber spp.; Elaphe spp.),* crows and ravens (*Corvus spp*.), rats (*Ratus norvegicus*), squirrels and chipmunks (*Sciuridae*) (Klimstra 1975, Murray 1957, Terres 1980). The bobwhite quail is also a popular game bird throughout much of its range, with days spent in the field by hunters also in decline in recent years.

The recovery of bobwhite quail may be difficult with an accelerating loss of available land to create and maintain quail habitat throughout its range. Restoring bobwhite populations range-wide will depend upon: 1) the amount of agricultural lands that are enhanced to provide nesting, brood rearing, and roosting habitats for quail and other grassland species; 2) the amount of pine dominated and mixed pine hardwood lands that are managed to provide open grass- and forb-dominated ground cover through thinning, harvesting, and periodic burning; and 3) the amount of rangeland that is managed to improve native plant communities and provide quail food and cover.

Populations of bobwhite quail on the Jefferson NF are very low with very few, small, and widely scattered areas of occupied range. The population level is presently considered unhuntable given their low numbers (Boynton, personal communication). Trends have been downward for many years with the decline of old-field habitat. One of the better populations occurred in the high elevation Crest Zone bald of the Mount Rogers NRA in the late 1980's through the mid 1990's but appears to have declined in recent years based on bird point count data. Prescribed fire has been used on a three year rotation since the late 1970's.

Direct and Indirect Effects

Habitat needs for northern bobwhite were considered during development of habitat management provisions by reviewing and incorporating elements of the Northern Bobwhite Conservation Initiative (Dimmick et al. 2002), a report by the Southeast Quail Study Group Technical Committee. Habitat provisions that are expected to lead to improved conditions for quail include those for restoration of woodlands, savannas, and grasslands, restoration and maintenance of open pine forests, creation of early successional forests, and maintenance of permanent openings. In addition, differing effects of alternatives on quail habitat are indicated under sections on Woodlands, Savannas, and Grasslands; Pine and Pine-Oak Forests; Successional Forests, and Permanent Openings. In general, alternatives that provide for higher levels of prescribed fire and vegetation management would favor quail habitat and populations.

Approximately 12,000 acres of permanent wildlife clearings presently exists on the Jefferson NF. This includes a mixture of developed clearings for wildlife, old fields, utility rights of way, road rights of way, pastures, and high elevation balds. The specific acreages and percentages of early successional habitat and permanent clearings for each alternative are shown in the effects analysis for Successional Forests and Permanent Openings, Table 3-42 and Table 3-49 respectively.

The perpetuation of old field habitats, balds maintenance, creation of early successional forest, and increased prescribed burning on the forest are likely to provide the best benefits to this species. Conversion of selected pasture areas to warm season grasses should also be considered and may be very beneficial toward bringing this species back. Allowing portions of developed wildlife clearings to revert from grass to shrub habitat may also improve habitat conditions.

Cumulative Effects

Cumulatively, trends in habitat quality and quantity on nearby private lands are likely to continue. The increased use of prescribed fire on national forest system lands is likely the most important effect we may have on quail habitat and their populations. Trends in the short-term (10 years) are expected to continue downward. Long-term trends may show some stabilization as additional habitat becomes more conducive to quail needs. Any increase in overall numbers is not expected to be measurable because such changes in quantity and quality of habitat take a long time to occur. Given the constraints of the plan and expected budgetary constraints, the needed habitat changes would not go far enough to under any alternative make a significant difference in quail habitat from the current situation. Although the plan improves conditions somewhat, the current decline in quality habitat, as previously described, is likely to continue for this species and others with similar habitat requirements over the life of this plan because of the insufficient amount and inadequate distribution of key habitat conditions.

American Woodcock

Although classed as a game bird, populations of woodcock have shown large declines in the eastern U.S. since surveys began in 1968 (Krementz and Jackson 1999). In the Southern Appalachians and Piedmont, breeding populations are highly variable in density and spotty in distribution. Wintering population densities vary from year to year, but the species is much more common and widely distributed in winter than in summer in the South. According to conservation status rankings, the woodcock is apparently secure in Alabama and Tennessee, and is secure in Virginia and Georgia; its status is unranked in South Carolina (Natureserve 2001). The woodcock is listed as a priority species under the Forest Service’s southern national forest migratory and resident landbird conservation strategy (Gaines and Morris 1996).

The American woodcock is closely associated with young, second-growth hardwoods and other early successional habitats that are a result of periodic forest disturbance (Straw et al. 1994). Ideal habitat consists of young forests and abandoned farmland mixed with forested land (Keppie and Whiting 1994). These include forest openings or clearings for singing displays in spring, shrubby thickets or other young hardwoods on moist soils for feeding and daytime cover, young second-growth hardwoods for nesting, and large fields for night-time roosts (Mendall and Aldous 1943, Andrle and Carroll 1988, Boothe and Parker 2000). European settlement and subsequent clearing presumably favored this species (Foss 1994).

To support woodcock populations, habitat structure appropriate for feeding, display/

roosting, and nesting all must be provided in suitable areas and in adequate configurations. Feeding habitat is much less open than display/roosting habitat and consists predominantly of second-growth (15-30-year-old) hardwood or mixed woods with shrubs, but also includes bottomland hardwoods, upland mixed pine-hardwoods, and mature longleaf pine after recent burning (Keppie and Whiting 1994). Dense thickets less than 20 years of age are especially important throughout much of the woodcock's range. Typical overstory canopy cover in daytime sites during breeding season is 53-64% (Dunford and Owen 1973). Shrub cover is also typically high (75-87%; Morgenweck 1977) and often adjacent to more open display habitat. Moist, generally loamy, soils are important for foraging, because they provide abundant and available earthworms, the woodcock's primary food.

Roosting and display habitat is typically open fields or regenerating forests. Maintenance of old fields for roosting and display habitat can be accomplished through disking, mowing, use of herbicides, and prescribed burns, although maintaining some small trees and shrubs is desirable. The goal is to create open habitats that are "patchy," rather than uniform in structure. As the ground and mid-story vegetation disappear through succession, woodcock will cease using the site (Krementz and Jackson 1999).

Silvicultural practices can also enhance habitat (Sepik et al. 1981, Rosenberg and Hodgman 2000). Clearcuts can provide good nocturnal roosting habitat. Furthermore, clearcutting small strips and blocks in mature woods in Maine has been shown to increase numbers (Dwyer et al. 1982a); new blocks or strips are cut every 8-10 years on a 40-50-year rotation to provide a continuous supply of young growth. McAuley et al. (1996) recommend maintaining at least 25% of land in early successional habitat by clearcutting blocks at least 5 acres, or 98 feet wide strips, in mature forest on a 40-year rotation. Stands dominated by shrub species may be encouraged and maintained by strip-cutting on a 20-year rotation for woodcock (Sepik et al. 1981). Shelterwood and seed trees left in partial timber harvests help to retain the patchy structure that woodcock prefer. Thinning and selection harvests can also improve dense forests for woodcock by allowing light to reach the ground. Boothe and Parker (2000) recommend burning slash from clearcuts to enhance these openings for woodcock nesting, courting and roosting. Shifts away from even-aged forest management may be detrimental to populations (Keppie and Whiting 1994, Rosenberg and Hodgman 2000).

Natural disturbances historically responsible for creation of early successional habitat also improve woodcock habitat. Beavers created extensive habitat, as did fire and possibly windstorms. In general, maintaining integrity of wetter sites such as springs, streams and creeks is beneficial to these species. Allowing thickets to grow in riparian areas will greatly improve habitat quality for woodcock, (Krementz and Jackson 1999). Grassy areas near water provide prime nesting and display grounds.

Non-breeding or wintering habitat is similar to breeding habitat but typically includes more open conditions such as sedge meadows, beaver pond margins, rice fields, upper reaches of estuaries and occasionally coastal meadows (del Hoyo et al. 1996). Winter habitats range from bottomland hardwoods to upland pine forests, young pine plantations, and mature pine-hardwood forests, though in some pine habitats the birds tend to focus their activities in lowlands dominated by hardwoods (Roberts 1993). Unlike during breeding, mature pine-hardwood and bottomland hardwoods are often preferred (Krementz and Pendleton 1994, Horton and Causey 1979). During the non-breeding season, woodcock generally occupy moist thickets in daytime, and shift to more open habitats such as pastures, fields (including agricultural), and young clearcuts at night. A diversity of habitat types and age classes may be especially important to survival when severe weather forces woodcock from preferred sites (Krementz and Pendleton 1994). The use of prescribed burns is a common forest management practice and can be used to set back plant succession. A light, controlled fire can maintain habitat patchiness as well. Burns may also remove pine needle cover, opening the ground to woodcock foraging. Mowing can also be used to improve foraging habitat, but appropriate habitat should be maintained for nesting birds (Roberts 1993).

Most woodcock use on the Jefferson NF occurs during migration periods. Nesting has been confirmed in Virginia and is probable on the Jefferson NF. Populations of woodcock appear very low and scattered on the forest. Trends along the east coast have been downward for many years.

Direct and Indirect Effects

Habitat needs for American woodcock were considered during development of habitat management provisions. Habitat provisions that are expected to lead to improved conditions for woodcock include those of development and/or maintenance of early successional riparian habitat, creation of early successional forests in general, and the development and maintenance of additional permanent openings. Differing effects of alternatives on woodcock habitat are indicated under sections on Riparian Areas, Successional Forests, and Permanent Openings. In general, alternatives that provide for higher levels of early successional forests would favor woodcock habitat and populations.

Approximately 12,000 acres of permanent wildlife clearings presently exists on the Jefferson NF. This includes a mixture of developed clearings for wildlife, old fields, utility rights of way, road rights of way, pastures, and high elevation balds. The specific acreages and percentages of early successional habitat and permanent clearings for each alternative are shown in the effects analysis for Successional Forests and Permanent Openings, Table 3-42 and Table 3-49 respectively.

The perpetuation of old field habitats, balds maintenance, creation of early successional forest, and increased prescribed burning on the forest are likely to provide the best benefits to this species. Allowing portions of developed wildlife clearings to revert from pure grass to patches of shrub habitat may also improve habitat conditions for the woodcock.

Hunter demand for this species appears to be relatively low on this forest. This may be because its numbers are low or because it is usually taken incidentally by grouse hunters.

Cumulative Effects

Cumulatively, trends in habitat quality and quantity on nearby private lands are likely to continue. Many riparian areas on private lands are being cleared of forest and permanently diverted to other uses reducing habitat for this species. Forest management trends tend to exclude development of early successional habitat within riparian areas. This is likely to adversely affect this species over time because of its preference for such habitat within these areas. Although the plan improves conditions somewhat, the current decline in quality habitat, as previously described, is likely to continue for this species and others with similar habitat requirements over the life of this plan because of the insufficient amount and inadequate distribution of key habitat conditions.

MIGRATORY SPECIES

Migratory birds have become a focus of conservation concern due to evidence of declining population trends for many species. To ensure that forest plan revision alternatives include provisions for migratory bird habitat, planning efforts included coordination with the Migratory Bird Office of the U.S. Fish and Wildlife Service and others under the umbrella of Partners in Flight (PIF). PIF is a cooperative effort involving partnerships among federal, state, and local government agencies, foundations, professional organizations, conservation groups, industry, the academic community and private individuals. It was launched in response to growing concerns about declines in populations of land bird species and to emphasize conservation of birds not covered by existing conservation initiatives.

PIF has developed Bird Conservation Plans for each physiographic area relevant to the national forest planning area. These plans are science-based, long-term, proactive strategies for bird conservation across all land ownerships and are designed to ensure long-term maintenance of healthy populations of native land birds. Forest Service biologists worked with PIF regional and local coordinators to identify key management issues and opportunities for high priority species on National Forest System lands, and developed related goals, objectives, and standards for incorporation into the Revised Forest Plan. In addition, *The Southern National Forest's Migratory and Resident Landbird Conservation Strategy* (Gaines and Morris 1996) was also reviewed and incorporated into planning efforts. This strategy identifies priority species and provides a framework for monitoring populations. The monitoring program described in this document is currently being implemented, and would continue under all alternatives.

Direct and Indirect Effects

Because migratory and resident landbirds are so ubiquitous and diverse, they are relevant to the majority of ecological communities and habitat elements considered during forest planning. As a result, provisions for these species are integrated into numerous plan objectives and standards focused on achieving desired habitat conditions. Effects of these provisions on ecological communities and associated species are addressed throughout the EIS. Effects to specific species of birds are addressed under appropriate sections for those chosen as Management Indicator Species (MIS). In addition, all relevant conservation priority species, as identified by the U.S. Fish and Wildlife Service, are assessed under the terrestrial species viability evaluation.

The majority of the Jefferson National Forest is contained within the Ridge and Valley Ecological Section, but there are also sections contained within the Blue Ridge and Cumberland Mountain Ecological Sections. The PIF plans and associated management issues for each of these areas will be addressed at some level in the Forest Plan Revision.

National Forests play an important role in conservation of bird species within the Ridge and Valley Section. Key landbird conservation issues within this Section are summarized below.

- Creation and maintenance of early succession shrub habitat is desirable in order to provide habitat for the Appalachian Bewick's Wren, golden-winged warbler, prairie warbler and whip-poor-will. Intensive surveys to determine the current use of the Forest by these species are needed. There are several management prescriptions that identify the need to provide large enough patches of early successional habitat for area-sensitive early successional species.
- Creation of structural diversity in mature stands to enhance conditions desirable for species such as the cerulean warbler, worm-eating warbler, and wood thrush. Mesic oak and mixed mesophytic stands can be evaluated for addition of canopy gaps and vertical structure through group selection and commercial thinning harvest programs.
- Protection and maintenance of northern hardwood/spruce-fir forests is a priority. The potential for restoration needs to be evaluated. This type is protected where it

occurs and the potential for restoration of additional acres needs to be evaluated.

The Mount Rogers National Recreation Area and the Glenwood Ranger District fall within the Blue Ridge Section, and therefore are covered by the PIF Bird Conservation Plan for the Southern Blue Ridge. Despite habitat protection on federal lands within the Southern Blue Ridge Area, 30% of breeding species have declined sharply in the last 30 years and an additional 18% have shown possible declines (Hunter et al. 1999). Key landbird conservation issues within this Section are summarized below.

- Conservation and restoration of spruce-fir and northern hardwood forest communities are important for associated boreal bird species. Spruce-fir forests are treated as rare communities in the Jefferson National Forest Plan and they will be maintained and restored across all alternatives. Standards protect the spruce-fir type from conversion to other forest types and from silvicultural practices except those designed to maintain or restore the type in all alternatives [Refer to section on Spruce Fir].
- Large patches of mature hemlock-white pine, northern hardwoods and mixed mesophytic (mesic hardwood) forests are uncommon due to past land management. Older stands of northern hardwood and mixed mesophytic hardwood forests cover only about 1% of the Southern Blue Ridge land base. There is a need to increase and maintain late successional acreage for these types. In addition, some low elevation forests, especially riparian forests, are fragmented on private lands. Regardless of Alternative, between 79 and 90% of the mixed mesophytic forest will be in a mid-late successional condition at the end of the next ten years, and after 50 years the range is expected to be between 61 and 98%. Alternative G results in less of this type being disturbed and Alternative F the most. Forests dominated by eastern hemlock will not be subject to regeneration harvest. Hemlock will be retained as patches during all silvicultural treatments [Refer to Sections on Mesic Deciduous Forests and Hemlock Forests].
- Many early successional species at mid- to high elevations have declined due to forest maturation, fire suppression, elimination of grazing, and decline in active forest management on federal lands. The Jefferson National Forest established an objective to create or maintain at least 285 acres of high elevation early successional habitat through forest regeneration and/or maintenance of balds, utility rights of way, old fields, and open woodlands [Refer to section on Balds, Successional Forests, and Permanent Openings].
- A predominance of forest stands in the 40-80 year age class on national forest system lands has resulted in a closed canopy condition with poorly developed understory and subcanopy. There is an overall lack of forest with "old growth" characteristics, including a multi-layered canopy, snags and downed woody debris. The Jefferson National Forest will be implementing canopy gap creation to enhance the understory for a variety of bird species [Refer to section on Mesic Deciduous Hardwood].
- Development of private land to resort, urban and suburban uses is creating increased fragmentation effects at a landscape level. See Section on Forest Interior.

In addition, a portion of the Jefferson National Forest is found within the Cumberland Mountains Section. Key landbird conservation issues within this Section are summarized below.

- A lack of old growth and early successional habitats characterizes the region.

Resulting middle-aged forests lack the appropriate structure for some mid- and understory breeding birds. In addition, appropriate management is needed to provide habitat for cerulean warblers.

- Restoration of low elevation yellow pine is desirable for those species requiring such habitat. Fire suppression has resulted in very little regeneration in this vegetation component.

In addition to providing a diversity of habitats for migratory birds on the landscape, collision of migratory birds with communications towers was considered during plan revision. The U.S. Fish and Wildlife Service (2000) has identified this as an issue needing attention:

"Construction of these towers (including radio, television, cellular, and microwave) increases at an estimated 6 to 8 percent annually in the United States. According to the Federal Communication Commission's *2000 Antenna Structure Registry*, the number of lighted towers greater than 199 feet above ground level (AGL) currently number over 45,000 and the total number of towers over 74,000. Non-compliance with the registry program is estimated at 24 to 38 percent, bringing the total to 92,000 to 102,000. By 2003, all television stations must be digital, adding potentially 1,000 new towers exceeding 1,000 feet AGL."…."The construction of new towers creates a potentially significant impact on migratory birds, especially some 350 species of night-migrating birds. Communications towers are estimated to kill 4-5 million birds per year."

Two mechanisms for bird mortality occur at communications towers (World Wide Web 2002). The first occurs when birds flying in poor visibility conditions do not see the structure (i.e., blind collision). Towers that are lighted at night for aviation safety may help reduce blind collisions, but they bring about a second mechanism for mortality. When there is a low cloud ceiling or foggy conditions, refracted light creates an illuminated area around the tower. Migrating birds lose their stellar cues for nocturnal migration and a broad orienting perspective on the landscape in these weather conditions. The lighted area may be the strongest cue for navigation, and birds remain in the lighted space by the tower. Mortality occurs when they collide with the structure and guy wires, or even other migrating birds, as more and more passing birds cram into the relatively small, lighted space. The lights apparently do not attract birds from afar, but hold birds that pass within the vicinity.

The Jefferson National Forest adopted forest-wide standards requiring removal of obsolete communications towers, location of new communication equipment on existing towers where possible, and coordination of new tower planning and construction with U.S. Fish and Wildlife Service in an effort to reduce tower collision mortality and to comply with the Migratory Bird Treaty Act, the Endangered Species Act, and the Bald and Golden Eagle Act.

Cumulative Effects

Because migratory birds cover such large areas, their conservation is dependent on the distribution of suitable habitats across large regions. Currently, national forests provide some of the largest blocks of forested habitat when viewed at a regional scale. As habitat quality and quantity continues to decline on many privately-owned lands due to conversion to urban and suburban land uses, national forest system lands will become even more critical to migratory birds in the future. Efforts by the Forest Service to coordinate closely with partners in bird conservation and to incorporate proactive conservation measures into forest plan revisions are designed to ensure national forests continue to support at-risk migratory birds.

BIOLOGICAL ENVIRONMENT

FISHERIES AND AQUATIC HABITAT

HABITATS

BIOTA

FISHERIES AND AQUATIC HABITAT

The Forest has approximately 1,053 miles of perennial streams and 1,970 miles of intermittent streams. Of the perennial streams, 300 miles are classified as supporting a cold water (less than 70 degree water temperatures) fishery, and 228 miles are classified as supporting cool or warm water fisheries (temperatures greater than 70 degrees during summer months). In addition, the Forest has 348 acres of lakes, ponds, and reservoirs greater than 1 acre.

HABITATS

WATER QUALITY

Water quality in the cold water stream habitat is generally described as infertile with total alkalinity less than 20 parts per million (ppm), and slightly to very acidic with pH as low as 4.8. It is estimated that 20 percent of headwater streams in Virginia are extremely sensitive to acidification (acid neutralizing capacity (ANC) between 20 and 50 microequivalents per liter, μeq/L). Another 24 percent experience regular episodic acidification at levels harmful to brook trout and other aquatic species (ANC between 0 and 20 μeq/L). The remaining 6 percent of streams are "chronically acidic" (ANC less than 0 μeq/L) and cannot host populations of brook trout or any other fish species (Bulger et al. 1998). Acid deposition coupled with poor natural buffering capacity may have increasingly negative impacts on the fisheries resource.

Water quality in the warm water stream habitat is generally higher in alkalinity and hardness, and not as susceptible to impacts from acid deposition because of more carbonate geology in the valley bottoms. Impacts to warm water streams often come from non-point source pollutants that enter the streams as they flow through private land. About 1,355 miles of 303(d) impaired waters are found within the 4th level HUC watersheds that include National Forest land. In all cases, the impaired segments are downstream from the National Forest. The causes of impairment come from a variety of sources including fecal coliform, urbanization, and chemical pollution (VA DEQ 2003).

PHYSICAL STREAM CONDITION

Over 465 miles (750 km) of physical stream habitat have been inventoried on the Jefferson National Forest. Approximately 43% of the streams surveyed did not meet the desired future condition of 200 pieces of large woody debris per mile (125 LWD/km) (see Figure 3-4). Large woody debris within a stream is ecologically important for instream habitat and productivity. Within the stream system, downed wood from riparian trees and shrubs greatly influence channel morphology and aquatic ecology. By altering 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).

BIOTA

The Southeastern United States supports the greatest diversity of freshwater mussel species in the world (Parmalee and Bogan 1998), and the richest freshwater fish fauna in North America north of Mexico (Warren et al. 2000). Looking at those species that are on or near the Jefferson National Forest, 62 species of fish and aquatic invertebrates are listed as threatened, endangered, or sensitive (see Table 3-62). Because these species are associated with aquatic habitats, the effects to these and aquatic locally rare (LR) species are included in the general direct, indirect, and cumulative effects analyses below, and also addressed in the next section.

Common native fish species in the cold water stream environments include brook trout, mottled sculpin, fantail darter, blacknose dace, longnose dace, and torrent suckers. Introduced species such as rainbow trout and brown trout are routinely stocked for sport fishing. In some Forest streams, these species have developed into naturalized populations. An effort has been made to eliminate introduced species from some native brook trout watersheds.

Wild trout (brook, rainbow, and brown) are indicative of cold water streams, good water quality and sedimentation rates that are in equilibrium with the watershed. In addition, trout are commonly fished and are a demand species. Wild trout were chosen as a Management Indicator Species (MIS) because many of the trout streams on the Jefferson National Forest support wild rainbow or brown trout populations in addition to the indigenous brook trout. MIS population trends and changes are analyzed for wild trout, rather than hatchery reared fish, since many stocked streams are not suitable for year-round survival or recruitment of a self-sustaining population.

From the report “Trout Stream and Environmental Inventory” (Mohn and Bugas 1980), the minimum viable population level for wild trout was determined to be 5 pounds per acre in flowing waters. Average trout populations approximate 30 pounds per acre for Virginia

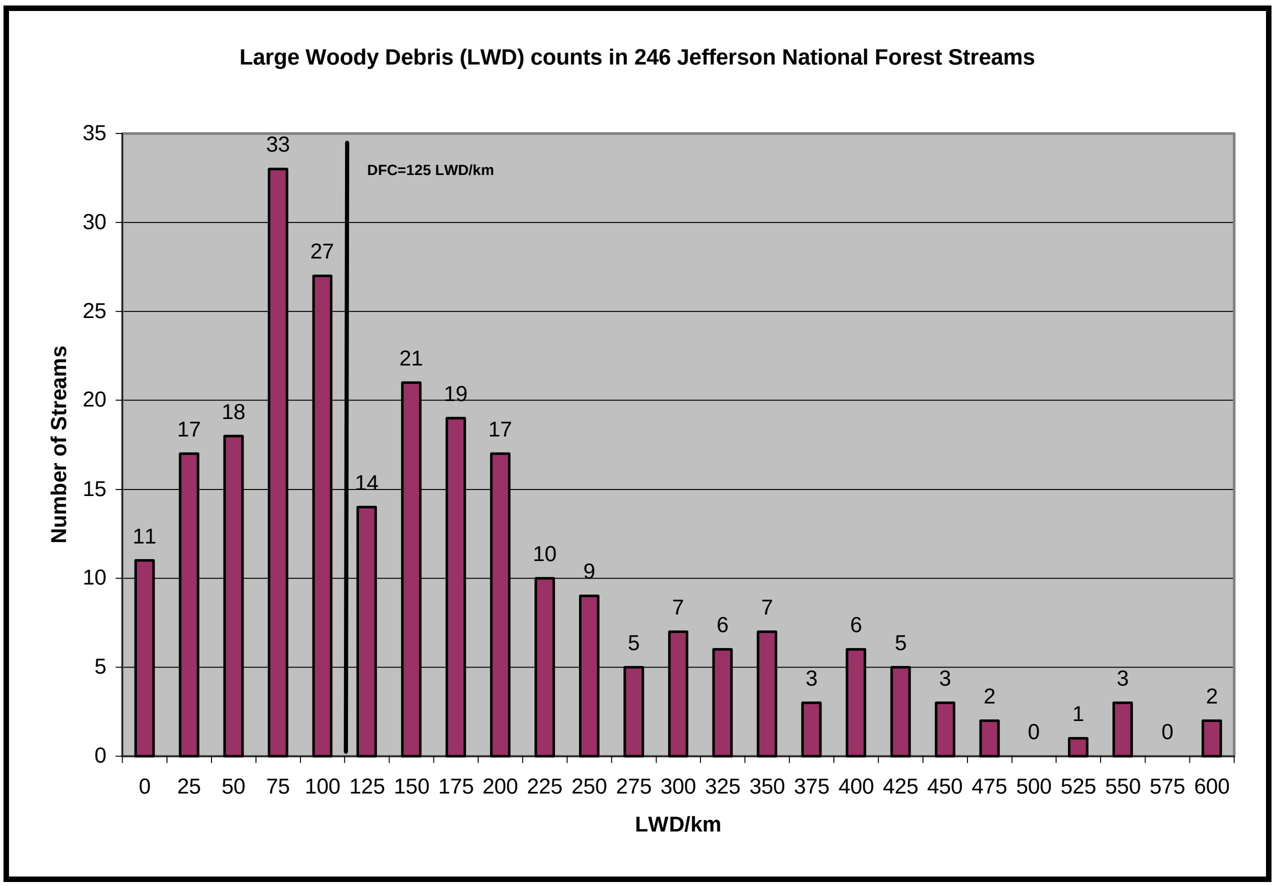

Figure 3-4. Large Woody Debris (LWD) counts in Jefferson National Forest Streams

BIOLOGICAL ENVIRONMENT

FISHERIES AND AQUATIC HABITAT

BIOTA

Table 3-62. Federally threatened (T) or endangered (E), and Forest Service sensitive (S) fish and invertebrate species on or near the Jefferson National Forest. (C=Candidate for federal listing, X=extirpated in VA or extinct)

Scientific Name	Common Name	Status
Acroneuria kosztarabi	Kosztarab's common stonefly	S
Ammocrypta clara	Western sand darter	S
Cottus baileyi	Black sculpin	S
Cumberlandia monodonta	Spectaclecase	S
Cyprinella monacha	Spotfin chub	T
Cyprogenia stegaria	Fanshell	E
Dromus dromas	Dromedary pearlymussel	E
Elliptio lanceolata	Yellow lance	S
Epioblasma brevidens	Cumberlandian combshell	E
Epioblasma capsaeformis	Oyster mussel	E
Epioblasma florentina walkeri	Tan riffleshell	E
Epioblasma torulosa gubernaculum	Green-blossom pearlymussel	EX
Epioblasma triquetra	Snuffbox	S
Erimystax cahni	Slender chub	T
Etheostoma acuticeps	Sharphead darter	S
Etheostoma osburni	Candy darter	S
Etheostoma percnurum	Duskytail darter	E
Etheostoma susanae	Cumberland Johnny darter	S
Etheostoma tippecanoe	Tippecanoe darter	S
Fusconaia barnesiana	Tennessee pigtoe	S
Fusconaia cor	Shiny pigtoe	E
Fusconaia cuneolus	Fine-rayed pigtoe	E
Fusconaia masoni	Atlantic pigtoe	S
Gomphus viridifrons	Green-faced clubtail	S
Hemistena lata	Cracking pearlymussel	E
Hydraena maureenae	Maureen's shale stream beetle	S
Ichthyomyzon greeleyi	Mountain brook lamprey	S
Io fluvialis	Spiny riversnail	S
Isoperla major	Beartown perlodid stonefly	S
Lampsilis abrupta	Pink mucket pearlymussel	EX
Lasmigona holstonia	Tennessee Heelsplitter	S
Lasmigona subviridis	Green floater	S
Lemiox rimosus	Birdwing pearlymussel	E
Leptophlebia johnsoni	Johnson's pronggill mayfly	S
Lexingtonia dolabelloides	Slabside pearlymussel	S
Megaleuctra williamsae	William's giant stonefly	S
Notropis ariommus	Popeye shiner	S
Notropis semperasper	Roughhead shiner	S
Noturus flavipinnis	Yellowfin madtom	T
Noturus gilberti	Orangefin madtom	S
Ophiogomphis alleghaniensis	Alleghany snaketail	S
Pegias fabula	Little-wing pearlymussel	E
Percina burtoni	Blotchside logperch	S
Percina macrocephala	Longhead darter	S
Percina rex	Roanoke logperch	E
Phenacobius crassilabrum	Fatlips minnow	S
Phenacobius teretulus	Kanawha minnow	S

Table 3-62. Cont'd. Federally threatened (T) or endangered (E), and Forest Service sensitive (S) fish and invertebrate species on or near the Jefferson National Forest. (C=Candidate for federal listing, X=extirpated in VA or extinct)

Scientific Name	Common Name	Status
Phoxinus tennesseensis	Tennessee dace	S
Plethobasus cyphyus	Sheepnose	S
Pleurobema collina	James River spinymussel	E
Pleurobema cordatum	Ohio river pigtoe	S
Pleurobema oviforme	Tennessee clubshell	S
Pleurobema plenum	Rough pigtoe	S
Pleurobema rubrum	Pyramid pigtoe	S
Quadrula cylindrica strigillata	Rough rabbitsfoot	E
Quadrula intermedia	Cumberland monkeyface pearlymussel	E
Quadrula sparsa	Appalachian monkeyface pearlymussel	E
Taeniopteryx nelsoni	Nelson's early black stonefly	S
Toxolasma lividus	Purple lilliput	S
Villosa perpurpurea	Purple bean	E
Villosa trabalis	Cumberland bean	EX

Department of Game and Inland Fisheries (VDGIF) identified Class I and Class II streams and averages 15 pounds per acre for Class III and IV streams.

Cool/warm water streams across the Forest vary greatly in water quality and productivity. Common game fish species found in cool/warm water stream environments on the Forest include smallmouth bass, largemouth bass, redbreast sunfish, channel catfish, and rock bass. Typical non-game species include white and redhorse suckers, carp, yellow bullhead, and a large variety of minnow and darter species.

Lake habitats on the Forest are relatively infertile with limited productivity. They routinely contain largemouth bass, bluegill, and channel catfish. Trout species are stocked in lakes that have significant cold water environments.

Aquatic macroinvertebrates integrate the physical, chemical, and biological components of the riparian ecosystem and have been successfully used as biological indicators of change and impacts (Environmental Protection Agency 1989). Aquatic insects make up the largest group of invertebrates that live in streams and other water bodies. Because of their usefulness as biological indicators, aquatic macroinvertebrates will be used in monitoring the Forest Plan. Analysis of 831 sites on the George Washington and Jefferson National Forests established the current range of conditions for aquatic macroinvertebrate communities across the four ecological units found on the Forests. In order to evaluate the current condition of a stream relative to others within the same ecological unit, a compilation of nine ecological aspects, or metrics, of these communities were developed based on the EPA's Rapid Bioassessment Protocol II. The nine metrics, called the Macroinvertebrate Aggregated Index for Streams or MAIS result in scores ranging from 0 to 18 (Smith and Voshell 1997). MAIS scores of 17-18 are "very good", 13-16 are "good", 7-12 are "poor/fair", and 1-6 are "very poor". The majority of the streams inventoried on the Forests (79%) fall into the "good" or "very good" category. These metric scores will be used as a tool for monitoring the effectiveness of the Forest Plan.

Direct And Indirect Effects

Currently, the biggest concerns for aquatic habitats on the Forest are sedimentation, future sources of large woody debris for self-maintaining diverse habitat components, canopy cover to maintain water temperature regimes, impacts from roads, and acid rain. Ground disturbing management activities in watersheds, particularly in the riparian areas, have the most potential for effects on fisheries and aquatic habitat resources on the Forest. Other threats include the removal of large trees that are located close to aquatic systems. These large trees provide shade, which aids in the regulation of stream temperatures. In addition, they are essential components in the continuous replacement of large woody debris to stream channels. Large logs and stumps create diverse habitat niches in streams vital to aquatic organisms.

Timber harvesting can directly affect sediment transport in streams if it increases (or decreases) the supply of sediment, if it alters the peak flow or the frequency of high flows, and if it changes the structure of the channel by removing the supply of large woody debris that forms sediment storage sites. Bank erosion and lateral channel migration also contribute sediments if protective vegetation and living root systems are removed.

If a forested riparian corridor was not left along the streams in a project area, reduction of streamside canopy could affect the physical characteristics of the stream channel and could also affect food quality and quantity for macroinvertebrates and other stream organisms directly and indirectly. Direct effects occur by changing the input of particulate food (leaf litter). Indirect effects come from alteration of the structure and productivity of the microbial food web through increased sunlight and modifying the levels of dissolved organic carbon and nutrients. Indirect effects of canopy removal may include increases in stream temperature. A 2-5^{o} C warming of small streams can affect life history characteristics of macroinvertebrates and developmental time of fish eggs (Sweeney 1993).

Roads affect the timing and volume of stream discharges by: intercepting and concentrating surface and subsurface flows; expanding or decreasing the channel networks; and reducing infiltration. The historic hydrological patterns within a watershed may be altered affecting the functions and processes to which the riparian and its inclusive aquatic communities have adapted. Roads located within the riparian corridor that either parallel or cross a stream present the greatest potential for allowing pollutants into surface waters. The use and construction of roads, log landings, trails, and other ground disturbing activities could increase the amount of erosion during periods of high flow. Sediment loading in streams affects the aquatic fauna directly and indirectly. Direct effects include damage to gills and body surface by abrasion by suspended particles. Indirect effects come from a reduction in available dissolved oxygen, a reduction in suitable habitat due to substrate being covered with sediment, a reduction in pool volume, and the filling of interstitial spaces. These all affect habitat quality and complexity.

Impoundments can alter flow regimes by changing the timing and quantity of instream flow below the reservoir. A decrease in water volume can lead to changes in channel morphology, and an increase in water temperature. Increased flow below an impoundment can lead to channel scour and flow levels that disrupt the reproductive cycle of aquatic organisms. For example, high flows could wash away glochidia or juvenile mussels. Impoundments also affect dissolved and particulate organic matter in the water column, and can change the natural temperature regime of a downstream river reach. These changes can affect the available food for aquatic organisms and create unsuitable thermal habitat. River habitat above an impoundment ultimately changes from a lotic to a lentic system.

Impoundments, as well as poorly designed road and trail stream crossings, can block fish passage thereby isolating upstream populations. Migration and movement of aquatic species are primarily restricted at road crossings by hanging culverts, high water velocity, inadequate swimming depth, or any combination of these three factors. Migration and movement barriers may be desirable (in rare cases) to protect a native species (brook trout) from a non-native competitor (rainbow trout). During watershed level analysis, the aquatic communities should be sampled above and below any culverts that could be barriers. Where the aquatic community above a culvert appears to have lost components, a decision should be made to either restock the unoccupied habitat through seining or electrofishing or replace the culvert to facilitate natural movement back into the area.

The limiting factor for meeting the chemical desired future condition is atmospheric deposition, something the Forest Service cannot control. This effect will not vary by alternative. The only way to change the chemical condition of the streams is to mitigate acidification directly through addition of limestone, or indirectly through participation in the development of air pollution emission regulations.

A discussion on the direct and indirect effects of the Forest Plan in relation to sediment produced by Forest Plan activities is found in the Water Resources section. This discussion is relevant, because sedimentation can cause negative effects to aquatic organisms, as described above. Chamberlin and others (1991) suggest determining whether sediment-supply increases will be meaningful by assessing initial and projected habitat conditions in relation to estimates of the natural variability in sediment regime. This was done in the Water Resources section, where interannual variability of sediment yield was determined for the Clinch River. Data from the Clinch provide a good but conservative estimate of the coefficient of variation for the other river systems evaluated in the sediment model. For direct effects, this was then compared to the percent increase over current sediment yields due to Forest Service activities. Because all modeled sediment increases from Forest Service activities for all alternatives are less than 5 percent (within interannual variability), for all practical purposes the sediment increase would not be detectible. For a sediment increase to be detectable, it would have to exceed the range of interannual variability for the watershed. In addition, the indirect effects analysis in the Water Resource section modeled sediment increases from activity on both private and National Forest land. Likewise, the percent increases in sediment were within the range of interannual variability and for all practical purposes are not detectable.

Aquatic habitats are included in the riparian management prescription (11), which does not vary by alternative. Under this management prescription, riparian areas and aquatic resources are managed to encourage the processes that maintain or lead to a desired future condition for fisheries and aquatic habitats. Riparian habitats and fisheries are sustained in a healthy condition. In most riparian areas, a slow progression toward a mature forest of more shade tolerant species occurs. More large woody debris is deposited into streams. Current fish management practices may be suitable such as stocking, streambank stabilization, use of habitat improvement structures, and use of mitigation measures for stream acidification.

The Plan designates riparian corridors for perennial and intermittent streams, and provides common standards for channeled ephemeral streams. The sediment model used in the Water Resource section does not consider the distance between soil disturbing activities and stream channels, and thus does not consider the riparian corridor widths as sediment buffers; it, therefore, overestimates the amount of sediment reaching a stream channel. This effects analysis was based on the assumption that the riparian corridor width is that found in the tables referenced in the riparian corridor management prescription. The riparian corridor will be managed to retain, restore, and/or enhance the inherent ecological processes and functions of the aquatic, riparian, and upland components within the corridor in all alternatives. These standards should have a beneficial effect on the communities and their associated species.

When projects are implemented with full consideration of the riparian management prescription and channeled ephemeral stream standards, no direct or indirect adverse effects to aquatic organisms or to the aquatic habitat that sustain them will occur. In order to verify that these standards are adequate, some ground disturbing projects will be monitored for: filter strip widths (implementation monitoring); off-site sediment movement; and aquatic invertebrate community composition (effectiveness monitoring).

Direct and Indirect Effects on Management Indicator Species

When projects are implemented with full consideration of the Riparian Prescription and channeled ephemeral stream standards, no direct or indirect adverse effects to wild trout will occur (Table 3-63). These standards should have a beneficial effect on wild trout and trout habitat. As previously stated, the limiting factor for the chemical condition of streams is atmospheric deposition, something the Forest Service cannot control. Brook, rainbow, and brown trout have different acid sensitivities. Brook trout are the most acid tolerant, and rainbow trout are the most acid sensitive of the three species. They will respond differently to acidifying streams. The Forest Plan allows for limestone mitigation of acidic streams, but this will certainly not occur on all streams that are becoming increasingly acidic. The Riparian Prescription and channeled ephemeral stream standards are the same for all alternatives, therefore, effects to trout will not vary by alternative. In the long term, if acid deposition from the atmosphere does not decrease, suitable trout habitat on the Forest may decline (SAMI 2002).

Table 3-63. Expected population trend[1] of wild trout on the Jefferson National Forest under forest plan revision alternatives 10 and 50 years following plan adoption. Population trend estimates are based on expected trends in habitat quantity and quality

Time Period	Alternative						
	A	B	D	E	F	G	I
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.

Cumulative Effects

Direct and indirect adverse effects to aquatic communities are minimized by the riparian and forest-wide watershed standards; however, they are not eliminated from the entire watershed. Incrementally, the adverse effects of Forest Service activities could accumulate to levels that threaten the viability of aquatic species. In addition to Forest Service lands, activities are also carried out on private lands in many of the 5th level watersheds. Since the viability of an aquatic species is generally assessed at the 5th level or higher watershed, it is important to consider all activities that might affect its viability regardless of land ownership.

A cumulative effects analysis should consider incremental impacts of actions when added to past, present, and reasonably foreseeable future actions. The analysis should include all actions regardless of who undertakes them. Cumulative impacts can result from individually minor but collectively significant actions taking place over time. For this document, cumulative effects were analyzed through a two-part watershed analysis, which included resource assessment and management prescription (Reid 1998).

First, a resource assessment was conducted using the Eastern Watershed Assessment Protocol (EWAP). Fifth Code HUC watersheds were evaluated in a GIS environment using information including, but not limited to: Virginia Department of Environmental Quality 303d report (impaired waters); Virginia Department of Conservation and Recreation 305b report (non-point source pollution); Virginia Department of Game and Inland Fisheries collection records; Virginia Division of Natural Resources collection records and reports; local knowledge of forest recovery from past conditions; local knowledge of current watershed problems; studies conducted by other Federal and State agencies; macroinvertebrate, stream habitat, and water chemistry information; and geographic information system layers of land use, point source, road and strip mine locations. This resource assessment provided the source of information used to evaluate the condition of each watershed.

Second, the condition of each watershed was evaluated through many meetings and discussions, which included not only multi-agency resource professionals, but members of the public as well. These occurred during Interdisciplinary Team meetings in 2001, which are documented in meeting notes published on the Internet: http://www.southernregion.fs.fed.us/gwj/lrmp/idt.htm.

Other individual watershed factors as well as combination of factors were considered and evaluated to determine the present condition of each watershed based on cumulative past and ongoing activities within it. These were used to validate the Watershed Condition Rank (WCR), as described in the Water Resources Section (Table 3-8).

Third, watershed condition was assessed using metrics representing each of four identified stressors related to the threatened, endangered, sensitive, or locally rare aquatic species found in each watershed (see the Aquatic Viability Section for further discussion). The Watershed Condition rating from Table 3-64 indicates which source of impairment (S, P, T or F), if any, is a major stressor in that watershed, and whether or not the Forest Service can measurably influence that impairment at the watershed level. Where the impairment is sediment (S), Forest Service influence is limited based on the WCR discussion below. Where the impairment is point source pollution (P) and altered flow (F), Forest Service influence is limited since there are no point source discharges into streams on the Jefferson National Forest, nor are there Forest Service proposals to build reservoirs or significantly modify flow. Where the impairment is temperature (T), the Forest Service can influence conditions at a local level by maintaining a streamside canopy, and in fact, the vast majority of Jefferson National Forest streams have forested buffers. However, it is often not sufficient to mitigate temperature increases that come from private land; therefore, the Forest Service influence on temperature at the watershed level is limited.

WCR characterizes cumulative effects of sediment from private and National Forest land within a specified watershed. It takes into account biological thresholds for sediment. Possible Watershed Condition Ranks are: Excellent (E); Average (A); or Below Average (BA). The below average (BA) WCR indicates that a biological threshold for effects from sediment is being reached. (See Table 3-8 in the Water Resources Section). The WCR for this analysis was developed from data specific to Virginia. As part of the watershed assessment, the WCR values were verified and adjusted according to local knowledge and data (described above and in the Water Resources section).

The only change in WCR in any of the watersheds under all alternatives is for watershed 0505000201. The change is from average (A) to below average (BA) in alternative D. As discussed in the Water Resources section, the change was from a slight shift that exceeded a class threshold, although the modeled sediment increase from National Forest activities remained small (4.74 percent).

Table 3-64. Watershed Condition for All Alternatives in the First Decade.

Watershed HUC	Ownership[a]	Watershed Condition[b]		
	Percent	Healthy	Risk 1	Risk 2
0208020103	28			P
0208020106	0			P
0208020107	10			SPT
0208020108	61	X		
0208020109	43			S
0208020205	4			SPT
0208020301	5			P
0301010101	1			SP
0301010102	1			SPT
0301010107	2			SP
0301010108	2			SPT
0505000101	3			SPT
0505000103	2			SPT
0505000104	9			SPT
0505000105	23		T	S
0505000106	4			SPT
0505000107	32		T	S
0505000108	18			ST
0505000110	10			SPT
0505000201	27		T	S
0505000202	31			S
0505000203	20			ST
0505000204	14			SP
0505000207	3			SPT
0505000210	0			SPT
0507020203	1			SP
0507020205	12			SPF
0507020206	0			SPF
0601010101	11			SPT
0601010202	15			SPT
0601020504	18			S
0601020505	9			SP
0601020601	9			SPF

a = “Ownership” is the percentage of the watershed managed by the Jefferson National Forest.

b= Under “Watershed Condition”: Low Risk indicates no impairment. Risk 1 indicates watershed impairment; however, Forest Service may influence conditions to improve the cumulative condition of the 5th level watershed. Risk 2 indicates watershed impairment; however, Forest Service opportunity to measurable affect the 5th level watershed is limited. Sources of impairment: S=sediment; P=point source pollution, T=temperature, F=altered flow, X=placeholder for watersheds with no impairment.

Concurrently with the resource assessment, the Forest carried out an interdisciplinary analysis looking at interactions between resources with a goal of managing riparian corridors to retain, restore, and /or enhance the inherent ecological processes and functions of the associated aquatic, riparian, and upland components within the corridor, while minimizing effects to aquatic and riparian resources from other activities. This was done through many meetings and discussions, which included not only multi-agency resource professionals, but members of the public as well. From this work, prescriptions, goals, objectives, and standards were developed in order to focus management on riparian, aquatic, and healthy watershed needs. This is documented in the proposed Forest Plan, Chapter 4, the identification of Priority Watersheds (Revised Forest Plan Table 2-1), and the development of Management Prescriptions 9A1 (Source Water Protection), 9A2 (Reference Watersheds), 9A3 (Watershed Restoration Areas), 9A4 (Aquatic Habitat Areas) and 11 (Riparian Corridors). These prescriptions were designed to not only minimize adverse impacts to aquatic and riparian areas, but to maintain them as healthy, functioning systems.

Resulting from the careful development of prescriptions and standards, there should be beneficial effects on in-stream uses (including federally listed aquatic species) during the implementation of the proposed Forest Plan. These beneficial effects include, but are not limited to: watershed restoration activities, road and recreation site maintenance, reconstruction, relocation, and/or closure/rehabilitation; and control and management of livestock. Buffer zone filter strips will limit sediment produced by ground disturbing activities (including road construction, firelines, trails, livestock grazing, wildlife habitat improvements, prescribed and wildland fire, recreation development, and timber harvest) from entering a stream system. Management of Federal leasable minerals according to standard lease terms, additional stipulations, surface use plan of operations, as well as Federal and State laws governing both private and Federal mineral development will limit sediment and other pollutants from entering a stream system. Management of streamside areas for riparian purposes and needs will increase large woody debris and shade. Stream crossings of roads and trails will allow the passage of desired aquatic organisms. The Revised Forest Plan contains an objective to quantify and maintain instream flow needs to protect aquatic organisms when new water use authorizations are proposed.

Forest objectives for watersheds with an Excellent or Average WCR are to maintain or improve aquatic health through the implementation of riparian management prescription standards. The probability is low to moderate, respectively, for adverse effects to aquatic species and their associated habitats in these watersheds. Forest objectives for watersheds with Below Average WCR are the same as watersheds with Average or Excellent WCR ratings with the additional requirement that during watershed assessments, surveys are conducted to determine the sources of impairment and prescribe appropriate treatments when they occur on National Forest system lands. Any effects from management activities will be insignificant or discountable and therefore, there will be no adverse cumulative watershed effects to aquatic species.

THREATENED, ENDANGERED, SENSITIVE AND LOCALLY RARE SPECIES

The Jefferson National Forest provides habitat for 10 federally threatened and endangered terrestrial species, which include 5 plants and 4 mammals, and one bird. There are 42 terrestrial species designated by the Regional Forester as sensitive. Sensitive species are designated by the Regional Forester, and include species occurring on the Forest with range-wide viability concerns, but which are not included on lists of endangered, threatened, proposed, or candidate species. Sensitive species receive special management emphasis in order to ensure their viability and to preclude trends toward federal listing or endangerment. These species come from various taxonomic groups: 1 bird, 1 mammal, 16 insects, 2 amphibians, and 22 vascular plants.

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The Forest's terrestrial threatened, endangered, and sensitive (TES) species occur in three ecological sections: the Blue Ridge Mountains, the Northern Ridge and Valley, and the Cumberland Mountains. Each of these sections contains distinct geologies and landforms, which give rise to a variety of unique habitats such as boreal forests, caves, wetlands, shale barrens, fire-adapted communities, glades, sinkholes, and springs. These unique habitats, in turn, support assemblages of rare plant and animal species. In addition to the habitat diversity found in the ecological sections, the Forest encompasses a wide range of latitude. Many plant and animal species more typically associated with northern or southern biomes reach the limit of their range on the Forest.

The aquatic threatened and endangered species list on the Jefferson National Forest includes 25 species. There are 37 aquatic species designated by the Regional Forester as sensitive, and 25 aquatic locally rare species.

The Forest is located within seven major river basins – the James, Roanoke, Kanawha (New), Big Sandy, Holston, Cumberland, and Upper Tennessee (Clinch and Powell). Each of these watersheds contains their own unique assemblages of aquatic species.

All threatened, endangered, and sensitive species were included in the viability analysis associated with this Forest Plan (see the next section of this Chapter). A review of affected environment for threatened, endangered, and candidate species, and direct, indirect, and cumulative effects to TES across alternatives, is included in this section.

Federally Listed Threatened and Endangered Terrestrial Species

Following is a brief description of each of the federally listed terrestrial plant and animal species currently known to exist on the Jefferson National Forest along with current management strategies for recovery.

Virginia Round-leaf Birch (***Betula uber***)

This species was listed under the Endangered Species Act in 1978. It had been considered extinct for over than 60 years when about 40 trees were rediscovered in1975 along Cressy Creek in southwest Virginia. Since that time, the number of trees in the natural, native population steadily declined until, in 1984, only 11 individuals remained. However, in the early 1980's an aggressive recovery plan, involving planting greenhouse-grown seedlings at various sites, was implemented. Although vandalism initially threatened the seedling recovery program, the total current population is now over 957 trees. Whether these immature trees will be capable of producing seed and competing successfully in these new locations remains to be seen (NatureServe Explorer 2001). Currently there is one wild population believed to contain 7 individuals. In the one wild population 5 individuals are presumed to exist on private land, (but this has not been verified for a long time) and 2 individuals are on Forest Service land. Twenty plantation populations that were established on Forest Service land between 1984 and 1987 (USDI Fish and Wildlife Service 1990d). In these plantations there are currently about 950 individuals. Due to the success of the plantations the species was downlisted to threatened by the USDI Fish and Wildlife Service in 1994 (USDI Fish and Wildlife Service 1994a).

There is a single naturally occurring population that occurs along the banks of Cressy Creek near Sugar Grove, Virginia. At this site the Virginia round-leaf birch is confined to a 700 meter stretch of streambank that is disturbed, second-growth forest. All the wild plants are within 30 meters of Cressy Creek. Extensive searches since 1975 have failed to locate any additional naturally occurring populations (USDI Fish and Wildlife Service 1990d). According to the recovery plan, this species requires exposed mineral soil with partly shaded conditions within 60 meters of multiple seed sources to reproduce itself. The two trees that occur on Forest Service land have been fenced to protect them from vandalism.

Of the original 1920 seedlings planted 950 remain. The trees in the plantations are maturing and no longer subject to damage by deer browsing and antler scraping. Perhaps the biggest threat to these trees is crowding by sweet birch. The plantation trees have not produced seed yet.

Direct and Indirect Effects

Vandalism was a major threat to survival after the species was rediscovered. However, due to a propagation program and establishment of plantations which are now maturing on the Forest, vandalism is not currently a major threat. At the naturally occurring site, erosion by Cressy Creek is a threat to the few wild individuals, however, flooding and flood scour may create suitable seedbed conditions. Succession and competition are also threats (Virginia Department of Conservation and Recreation 1996). Limiting factors include a limited number of small forest openings with exposed mineral soil in the immediate vicinity of seed sources, herbivory, long distances between pollen sources, and a breeding system which may be developmentally retarded and permits heavy gene exchange with sweet birch (USDI Fish and Wildlife Service 1990d).

The implementation schedule for the Virginia round-leaf birch recovery plan (USDI Fish and Wildlife Service, 1990d) includes five items that directly relate to current and future Forest Service management:

- Protect existing habitat;
- Monitor individuals in original population;
- Encourage natural regeneration;
- Maintain additional populations;
- Expand management zone

Under all alternatives, except F (the 1985 Forest Plan), this site will be allocated as management prescription 4D, the Special Biological Area designation. Under this prescription, lands contain individual threatened, endangered, sensitive, and locally rare plant or animal communities found within major forest communities, not within a rare community. The goal of designation and management of these areas is to perpetuate or increase existing individual plant or animal species that are of National, regional, or State significance as identified on TES lists. These lands are classified as unsuitable for timber production, although timber harvest to meet the long-term goals of the desired condition is appropriate. Desired conditions include the following at each site: (1) protection of threatened, endangered, sensitive, or locally rare species from human taking or human-caused detrimental habitat changes; (2) viable and increasing populations of threatened, endangered, sensitive, or locally rare species; and (3) functioning ecosystems.

In addition, Forest-wide standards in all alternatives that provide protection to this species are those standards that protect individuals and sites of federally listed species and those that control non-native invasive species where they are adversely affecting federally listed species.

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Cumulative Effects

Nearly all round-leaf birch trees near the original site (including the plantations) occur on the Forest. Because of this and the protective measures in all alternatives, there will be no cumulative effects to this species.

SMALL WHORLED POGONIA (*ISOTRIA MEDEOLOIDES*)

The small whorled pogonia (*Isotria medeoloides*) was listed by the USDI Fish and Wildlife Service as endangered in 1982 and revised to threatened status in 1992 based on discovery of new sites, achievement of protection for many of the sites, and additional life history and population information. Much of the information used in this analysis is from the revised recovery plan (USDI Fish and Wildlife Service 1992b) written for the species.

Isotria medeoloides (Pursh.) Raf. is a federally listed orchid known from 16 states, including Virginia, West Virginia, North and South Carolina, Georgia and Tennessee (NatureServe 2001). This species occurs in three primary population centers: New England; the southern extreme of the Appalachian Blue Ridge at the juncture of North and South Carolina, Georgia, and Tennessee; and the coastal plain and piedmont region of Virginia, with outliers in Delaware and New Jersey. Disjunct populations occur in six sites in Pennsylvania, Ohio, Michigan, Illinois, and Ontario (USDI Fish and Wildlife Service 1992b). In the Southern Appalachian planning region, the only small whorled pogonia sites occurring on National Forest Service lands are located on the Chattahoochee, Sumter, and Jefferson National Forests. This species is found primarily in second and third-growth deciduous and mixed-deciduous/coniferous forests. Ages of the older trees on the sites vary from as young as 30-years- old in South Carolina to 80-years-old in Virginia. The forest habitat in which this orchid is found is not rare, yet only a small percentage of the habitat has colonies of small whorled pogonia. Site characteristics are highly variable, but are usually mesic, with sparse to moderate ground cover and a relatively open understory canopy. Old logging roads or streams are often nearby. Many sites show signs of past agricultural use (USDI Fish and Wildlife Service 1992b).

There is one known site for this species on the Forest, with a population of nine plants (Van Alstine, N. et al. 1996; Huber, F. 2003).

Direct and Indirect Effects

The primary threat to the small whorled pogonia throughout its range is habitat destruction by residential and commercial development. Collection of plants, recreational use, herbivory, and inadvertent damage from research activities are also cited as harming populations. Whereas heavy timbering and clear-cutting are considered threats, selective timbering may not be harmful to a population (USDI Fish and Wildlife Service 1992b).

At some small whorled pogonia sites there is a concern that under-and midstory vegetation may be shading plants and possibly causing a decline in individual colonies. Vegetative removal studies have been conducted in Maine in 1993 and 1996, with possible positive response of the *Isotria* to the increased light at the forest floor (Dibble et al. 1997). Vegetative removal studies began in New Hampshire in 1998, but will take at least five years to determine any effects of the removal (Sperduto, M. 1998). The recovery plan identifies the need for further research into effects of vegetation removal in small whorled pogonia sites, and thus there is an opportunity for the national forests to experiment with such removal. Any risks of habitat manipulation through vegetation manipulation would likely be outweighed by potential benefits to the species (USDI Fish and Wildlife Service 1992b) Because the orchid is protected under the Endangered Species Act, no activities with potential to affect the plants either adversely or beneficially can take place in the sites without concurrence from, or consultation with, USDI Fish and Wildlife Service.

The Recovery Plan for Small whorled pogonia (USDI Fish and Wildlife Service 1992b) lists several implementation tasks for recovery of the species. Those listed for federal agencies consist primarily of protection through existing laws and coordination with other governmental agencies and conservation organizations. The Forest has been implementing these tasks as well as conducting inventories for new locations of the orchid.

Under all alternatives, except F (the 1985 Forest Plan), single known population of small whorled pogonia pogonia is protected through allocation as management prescription 4D, the Special Biological Area designation. Under this prescription, lands contain individual threatened, endangered, sensitive, and locally rare plant or animal communities found within major forest communities, not within a rare community. The goal of designation and management of these areas is to perpetuate or increase existing individual plant or animal species that are of National, regional, or State significance as identified on TES lists. These lands are classified as unsuitable for timber production, although timber harvest to meet the long-term goals of the desired condition is appropriate. Desired conditions include the following at each site: (1) protection of threatened, endangered, sensitive, or locally rare species from human taking or human-caused detrimental habitat changes; (2) viable and increasing populations of threatened, endangered, sensitive, or locally rare species; and (3) functioning ecosystems.

In addition, Forest-wide standards in all alternatives that provide protection to the small whorled pogonia are those standards that protect individuals and sites of federally listed species and those that control non-native invasive species where they are adversely affecting federally listed species.

Cumulative Effects

There are no identified cumulative effects to the single known population of small whorled pogonia on the Forest under any alternative.

NORTHEASTERN BULRUSH (***SCIRPUS ANCISTROCHAETUS***)

Unless otherwise noted, the information used in this analysis comes from NatureServe (accessed in 2001).

Northeastern bulrush was listed as endangered under the Endangered Species Act in 1991. Populations are known from MA, MD, NH, NY (presumed extirpated), PA, VA, VT, and WV. The habitat seems to vary geographically, although there are not enough sites to allow generalizations to be made. However, one does observe that in the south, sinkhole ponds are the most common habitat for the plant, and in the north, other kinds of wetlands, including beaver-influenced wetlands, provide suitable habitat.

There are about 55-60 extant occurrences known in the Appalachians from southern Vermont and New Hampshire to western Virginia, with most occurrences in Pennsylvania. Most of the known sites have small populations (10 historical occurrences have been searched for unsuccessfully.) The plants are restricted to fairly specific wetland habitats that are infrequent, especially in the southern part of the range. Various threats are associated with the habitat, including drainage and development, agricultural runoff, and any developments that could alter the local hydrology. Additional, unsurveyed habitat does exist, and more populations of this species may be found in the future if the potential habitats remain intact.

Long-term monitoring of known sites is needed before any conclusions can be drawn about the habitat needs of the plant, or about the stability of its populations in changing environments.

The implementation schedule for the northeastern bulrush recovery plan (USDI Fish and Wildlife Service 1993) includes five items that directly relate to Forest Service management:

- Secure permanent protection for known populations;
- Resurvey sites thought to have suitable habitat;
- Verify, monitor, and protect any additional populations;
- Identify potentially suitable habitat for additional surveys; and
- Survey potential sites.

Throughout its range, northeastern bulrush is found in open, tall herb-dominated wetlands. Often it grows at the water's edge, or in a few centimeters of water, but it may also be in fairly deep water (0.3-0.9 m) or away from standing water. In the southern part of its range, the most common habitat is sinkhole ponds, usually in sandstone. Water levels in these ponds tend to vary both with the season and from year to year. At least one site (in Massachusetts) is in a sand plain, where water level fluctuates as well. Two sites in Vermont are influenced to some extent by beaver activity as well as other hydrological factors.

With the information available it is difficult to compare sites throughout the plant's range. For example, lists of associated species may represent an entire wetland or the immediate vicinity of the plant, but this is not always possible to determine from available information. Nevertheless, examination of field reports indicates that there is considerable variety in associated species. A few species, however, are common to several of the sites. These are *Dulichium arundinaceum, Scirpus cyperinus* sens. lat*., Glyceria canadensis,* and *Triadenum virginicum*.

Six populations of northeastern bulrush are known from Virginia. All of the sites are in the mountainous, western part of the state, near the West Virginia border. The total state population is estimated at 300 individual plants. The six sites are discussed in turn. Site One is a tiny ridgetop pond on sandstone, in shallow water, at elevation 1170 m. No current information is available on the site. Site Two consists of two shallow sinkhole depressions at 372 m elevation. In 1987, one had standing water and the other did not. The shallower, drier pond had the larger population of northeastern bulrush. In all, approximately 100 plants (clumps) were seen at the site. Site Three is an open, mountain pond at 744 m, with much aquatic vegetation and no shrub border. In 1985, plants were scattered along the edge of the pond, with *Dulichium arundinaceum, Carex canescens* and *C. vesicaria.* Site Four is a small pond in a saddle between two ridges, at 1074 m elevation. The pond has open water, with emergent vegetation around the edges and a shrub border. Northeastern bulrush grows with *Dulichium arundianaceum, Glyceria acutiflora* and *Carex stricta*. Sites Five and Six are two small sinkhole ponds at 405 m, in an area containing numerous small ponds and forested wetlands. In each pond, the plants were found in standing water. The plants are near the ponds' edge as well as closer to the center of the ponds. In a 1989 visit, the first pond had about 25 plants, with 44 fertile culms. The second had about 10 plants, with 26 fertile culms. No evidence of vegetative reproduction was noted at these or any of the other Virginia populations. Associates were *Eleocharis quadrangulata, Scirpus torreyi, Dulichium arundinaceum, Cephalanthus occidentalis, Leersia oryzoides,* and *Eleocharis cf. palustris*.

Direct and Indirect Effects

Among the potential human threats are agricultural runoff, construction of logging and fire roads, development, all-terrain vehicle use, collection, and dredging.

In addition to human activity, there may be natural threats to the species as well, although more information about the biology and ecology of the species is needed before these influences can be clearly implicated in the decline of the species. Among possible natural threats are deer, beaver (one Vermont population has suffered alarming fluctuations, apparently as a result of beaver activity), natural water level fluctuations, fire (this may have damaged a population in Pennsylvania), and succession (it has been suggested that this may adversely affect populations in West Virginia and Maryland).

Fluctuations in population size have been observed at several localities for the species. It is very likely that botanists visiting the known sites for the species do not identify vegetative plants, and it is postulated that the fluctuations are in number of flowering/ fruiting culms rather than actual number of plants.

On the Forest, northeastern bulrush occurs at one site:

Potts Mountain Pond – In 1987, the total population covered an area of about ten square meters and consisted of several hundred plants (Virginia Department of Conservation and Recreation 1996). At this site the greatest threats are alteration of hydrology, either through draining the pond or changes in the inputs of surface and groundwater, and off highway vehicles (OHV's). The Potts Mountain Trail, an OHV trail, passes near the pond.

Under all alternatives, except F (the 1985 Forest Plan), this site will be allocated as management prescription 9F, Rare Community. The Rare Community type is Mountain Pond. Rare communities are assemblages of plants and animals that occupy a small portion of the landscape, but contribute significantly to plant and animal diversity. Rare communities, wherever they occur on the forest, are managed under this prescription to ensure their contribution to meeting goals for community diversity, endangered and threatened species recovery and habitat for sensitive and locally rare species. These lands serve as core areas for conservation of the most significant elements of biological diversity identified to date on the Forest. Recreational access may be limited by signs and barriers, where necessary, to protect community integrity. Interpretive signs or other information may be available where it is likely to promote public knowledge of rare communities and improve community protection.

In addition, Forest-wide standards in all alternatives that provide protection to this species are those standards that protect individuals and sites of federally listed species and those that control non-native invasive species where they are adversely affecting federally listed species.

Cumulative Effects

The one known occurrence of this species on the Forest is protected under all alternatives, except F (the 1985 Forest Plan), as management prescription 9F, Rare Community. The cumulative impacts of the OHV trail that passes near the pond have the potential to negatively affect the pond and the northeastern bulrush through illegal OHV use (driving through the pond or creating deep ruts that affect hydrology) or through maintenance of the OHV road affecting the hydrology of the area. Standards in management prescription 9F allow OHV use to be managed to protect this plant.

VIRGINIA SPIRAEA (***SPIRAEA VIRGINIANA***)

Virginia spiraea is a southern Appalachian endemic occurring in the southern Blue Ridge and Appalachian Plateau physiographic provinces (Ogle 1991). This species was listed as

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threatened on June 15, 1990. Virginia spiraea species is a clonal shrub that reproduces completely or almost completely through vegetative means. Habitat is rocky, flood-scoured riverbanks in gorges or canyons, where woody competition is reduced and riverwash deposits create sites for vegetative propagule establishment (USDI Fish and Wildlife Service 1991c). NatureServe (2001) describes the habitat as periodically flood-scoured banks of high-gradient mountain streams or along lower stream reaches. Plants are often found on geologically active areas with erosion, deposition, and slumping, along rivers with dynamic flooding regimes, sandbars, scoured river shore and flatrock habitat with crevices. These areas also are associated with cobbles, boulders, and massive rock outcrops with sandy or clay soils. The areas can be periodically xeric. Plants are often seen in silt mud and sand.

NatureServe Explorer (2001) provides detailed information on physical habitat and associated species for occurrences of this species. The Recovery Plan for Virginia spiraea (USDI Fish and Wildlife Service 1991c) summarizes the number of clones by state and by ownership.

On the Forest, Virginia spiraea occurs at three sites:

Pound River – In 1987, 4 clumps of vigorous plants (Virginia Department of Conservation and Recreation 1996).

Chimney Cliffs/Russell Fork – 3 occurrences at this site, the largest is on Forest Service land. In 1995 this occurrence consisted of 25-30 clumps in a 10 x 15 meter area. Vigorous vegetation reproduction was taking place. The other two occurrences are in Breaks Interstate Park or private land (Belden, A. Jr. and W.H. Moorhead III 1996).

Guest River Gorge – In a 1993 survey, 100+ clumps in five subpopulations along about 1.1 mi. of river (Ludwig, J.C., A. Belden, and C.A. Clampitt 1994).

Direct and Indirect Effects

Threats include reservoir construction (inundation of plants or alteration of natural flood regimes), human disturbance of riverbank habitats, and competing vegetation (USDI Fish and Wildlife Service 1991c).

Negative impacts from recreational use are the greatest threat on the Forest. In West Virginia, recreational activities including fishing, hiking, camping, and boating have damaged nearly all sites (West Virginia Department of Natural Resources 2000). Competition from other plant species is the other serious threat. In some cases, alteration of normal flood scour events may allow native competing vegetation to affect Virginia spiraea populations. Forest-wide standards in all alternatives that provide protection to this species are those standards that protect individuals and sites of federally listed species and those that control non-native invasive species where they are adversely affecting federally listed species.

All alternatives, except F (the 1985 Forest Plan), contain objectives taken from the recovery plan (USDI Fish and Wildlife Service 1991c) and includes language that would encourage re-introduction within in historic range. Opportunities may exist in the future to re-establish this species on the Forest.

The implementation schedule for the Virginia spiraea recovery plan (USDI Fish and Wildlife Service 1991c) includes five items that directly relate to Forest Service management:

- Identify and monitor threats to each existing population;

- Enforce laws protecting the species and/or its habitat;
- Conduct range-wide searches for additional populations;
- Conduct site-specific manipulation to maintain existing populations; and
- Reintroduce the species within its historical range.

Under all alternatives, except F (the 1985 Forest Plan), known locations of Virginia spiraea are protected through allocation as management prescription 4D, the Special Biological Area designation. Under this prescription, lands contain individual threatened, endangered, sensitive, and locally rare plant or animal communities found within major forest communities, not within a rare community. The goal of designation and management of these areas is to perpetuate or increase existing individual plant or animal species that are of National, regional, or State significance as identified on TES lists. These lands are classified as unsuitable for timber production, although timber harvest to meet the long-term goals of the desired condition is appropriate. Desired conditions include the following at each site: (1) protection of threatened, endangered, sensitive, or locally rare species from human taking or human-caused detrimental habitat changes; (2) viable and increasing populations of threatened, endangered, sensitive, or locally rare species; and (3) functioning ecosystems.

Cumulative Effects

There are no identifed cumulative impacts to Virginia spirea under any alternative.

PETERS MOUNTAIN MALLOW (*ILIAMNA COREI*)

This species was listed as endangered under the Endangered Species Act on June 11, 1986. There is only one known natural occurrence of this species. Peters Mountain Mallow was discovered in 1927 at which time there were perhaps 50 plants. The population declined steadily until, by the late 1980's, there were just three plants. A fourth plant was found in 1990 (USDI Fish and Wildlife Service 1990c). Threats include fire suppression, which is needed for seed germination and to maintain habitat, overgrazing by deer and feral livestock, and collection by people (NatureServe 2003). The site was acquired by The Nature Conservancy and prescribed burning began in 1992 has produced hundreds of new plants. The recovery plan did not assign the U.S. Forest Service any tasks, however the Forest has assisted with prescribed burning efforts.

Direct and Indirect Effects

Peters Mountain Mallow does not occur on the Forest, therefore none of the alternatives will affect this species. The Forest will continue to assist The Nature Conservancy as needed and requested in the recovery of this plant.

Cumulative Effects

Because this species does not occur on the Forest there will be no cumulative effects.

VIRGINIA BIG-EARED BAT (*CORYNORHINUS TOWNSENDII VIRGINIANUS*)

Formerly included in the genus Plecotus, the Virginia big-eared bat is a subspecies of the more common and widespread Western (or Townsend's) big-eared bat that occurs throughout the western U.S., southwest Canada, and most of Mexico. The subspecies, virginianus, occupies a very limited geographic range in the Central Appalachians. Population numbers have shown moderate to strong increases range-wide over the past 15 years. In the late 1980's it was estimated the total population of the subspecies in

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West Virginia, Virginia, Kentucky, and North Carolina to be approximately 10,000 bats (Dalton 1987). By 1997 the range-wide population of *C.t. virginianus* was estimated to have almost doubled at less than 20,000 individuals (Pupek 1997). In West Virginia some cave populations grew as much as 350% from 1983 to 1995 (Pupek 1997). In Virginia this bat is known from eight caves in five counties in two separate geographic areas. One is in the upper headwaters of the James River (Cowpasture River) and the other is in the New River watershed. According to the Virginia Fish and Wildlife Information Service, it is known from three caves in Tazewell County during the summer and five caves during the winter in Tazewell, Bland, and Highland Counties. Previous observations of cave occurrences in Rockingham, Bath, and Pulaski Counties have not been seen in recent years. The Virginia big-eared bat occupies caves year-round. These bats are not migratory and their longest recorded movement is only 64 kilometers (almost 40 miles) (Dalton & Handley 1991). Males and females hibernate singly or in mixed clusters in a few caves then move in the spring to other cave(s) with females forming smaller summer maternity/nursery colonies and males being solitary or in bachelor groups during that season.

Mating begins in late summer/early autumn and continues into early winter. Ovulation and fertilization are delayed until late winter/early spring. Maternity colonies form as early as March or as late as June depending on when the roost site reaches a suitably warm temperature. Gestation lasts 2-3.5 months. A litter of one is born in late spring/early summer. Young can fly at about 2.5-3 weeks of age, weaned by 6-8 weeks, and leave the cave to forage on their own by the end of July or August. Most individuals leave the nursery cave by mid to late September. Females are sexually mature their first summer. Males may not be sexually active until their second year. Nearly all adult females breed every year (NatureServe 2003).

The Virginia big-eared bat is primarily a feeder on moths. Food habits of the maternity colony in Tazewell County found that moths formed over 90% of the diet with beetles a distant second followed by lesser quantities of other flying insects. Foraging activity typically occurs within 2 miles of summer roost caves. Bats have been observed foraging over corn and alfalfa fields as well as mature upland forests, wherever moths occur in abundance (Dalton et al. 1986).

Limiting factors for the Virginia big-eared bat include caves with suitable temperature regimes (cold in winter and warm in summer). This bat tolerates lower cave temperatures during hibernation than other bats and often occupies areas in caves that receive cold-air flow near entrances. Maternity colonies are typically warmer than those used for hibernation. Declines appear to be primarily related to human disturbance and loss of cave habitat quality. The Virginia big-eared bat is extremely intolerant of any human disturbance. The growing popularity of spelunking is a tremendous threat to these bats. Former decline probably is attributable to human intrusion into caves, which depletes energy reserves of aroused bats and may lead to cave abandonment if disturbance is frequent, (NatureServe 2003). The recovery plan (USDI Fish and Wildlife Service 1984) recommends recovery actions focused on cave acquisition and gating of entrances to control human access.

On the Forest there are no caves occupied by the Virginia big-eared bat at any time of the year. All occupied caves in Virginia, during both summer and winter, are on private land. Cave occurrences of the Virginia big-eared bat close to the Forest are located in Bland and Tazewell Counties. The bat is known to forage over land of the New River Ranger District in the Burkes Garden – Tazewell Beartown area and perhaps a portion of Walker Mountain.

Direct and Indirect Effects

Under all alternatives, forestwide standards relevant to the Virginia big-eared bat and its cave habitat would protect all caves that are discovered or purchased that support Virginia big-eared bats. Although no hibernacula or summer roost caves have been identified on the Forest, forest-wide standards maintain vegetation and require installation of gates or other protective structures at entrances of all caves occupied by populations of any threatened or endangered bats. Until a newly discovered cave has been surveyed for bats, it is assumed that federally listed bats are present and the cave and surrounding habitat are maintained for them until surveyed.

There will be no affect on foraging habitat from implementation of any alternative since foraging habitat around Burkes Garden is in Congressionally designated Wilderness (management prescription 1A - Beartown Wilderness) or Appalachian Trail (management prescription 4A) and vegetative conditions as seen today will continue with any changes resulting from forest succession and natural disturbances. The same can be said for National Forest land near the Bland County occurrence. The northwest side of Walker Mountain is in the Primary buffer Indiana bat cave management prescription (8E4a) because Indiana bats also occupy the same cave where the Virginia big-eared bats have been known to occur. On the southeast side of Walker Mountain, just over the ridgecrest, the management prescription is either recommended wilderness or backcountry recreation in all alternatives.

Cumulative Effects

There are expected to be no cumulative effects to the Virginia big-eared bat resulting from implementation of any alternative. As stated above, the caves where this species occurs are on private land near the Forest. Landowners of these caves are aware of the bats presence and the caves are either gated or protected to limit human entrance and disturbance. Individual Virginia big-eared bats occasionally forage over National Forest land, but vegetative conditions will be maintained based on standards associated with prescription allocations under all alternatives. It is therefore probable that insect populations (especially moths) will continue and be maintained so foraging will not be effected. In the northern portion of the Virginia big-eared bats range there have been concerns about the effect gypsy moth (Lymantria dispar) defoliation and suppression efforts may have on Virginia big-eared bats. Defoliation and the subsequent short-term loss of forest cover may suppress insect populations and thus food sources for the bats. Likewise the use of certain pesticides suppresses or eliminates insect populations to varying degrees and lengths of time depending on the type of insecticide used (USDA 1995). Gypsy moths are slowly moving south but not expected to become established in the areas where Virginia big-eared bats occur on or near the Forest for several years. If and when necessary, decisions on gypsy moth management will be made at that time and handled at a project level.

GRAY BAT (***MYOTIS GRISESCENS***)

The gray bat occupies a limited geographic range in limestone karst areas of the southeastern U.S. from southwest Virginia west to Missouri then south to eastern Oklahoma and northern Florida (USDI Fish and Wildlife Service 1982). Similar to bat species like the Virginia big-eared bat, the gray bat is narrowly restricted to cave habitats and occupies caves year-round. They hibernate in huge numbers in a few caves then spread-out in the summer with females forming smaller summer maternity colonies and males forming small bachelor colonies in separate caves. About 95% of the known population inhabits eight major caves during the winter (Harvey 1992). They may occasionally utilize non-cave roosts such as storm drains and mines or even old buildings (NatureServe 2003). Migration distances between summer and winter caves range from 17-525 kilometers (10-325 miles) and small caves may be used as rest stops (NatureServe 2003).

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Limiting factors for the gray bat include caves of an appropriate size (large, complex) with suitable temperature regimes (cold in winter and warm in summer). The key cause of decline appears to be human disturbance and loss of cave habitat quality. The gray bat is highly intolerant of any human disturbance. The recovery plan (USDI Fish and Wildlife Service 1982) recommends actions focused on cave acquisition and gating.

Extensive vegetative changes around occupied cave entrances and in between caves, especially along large water sources (feeding corridors), may have a detrimental effect. They do not feed in areas along rivers and reservoirs where forest vegetation has been cleared (LaVal et al. 1977). Forest cover provides protection from predators for adult and young bats. Retention of forested corridors around cave entrances, along river and perennial stream edges, and along reservoir shorelines within 15 miles of known gray bat maternity caves is important (USDI Fish and Wildlife Service 1982; LaVal et al. 1977; Best et al. 1995).

Although the gray bat is currently listed as endangered, some bat researchers have endorsed a proposed status change to threatened due to population increases and successful protection of many inhabited caves (Currie & Harvey 2002). Gray bats are now estimated to number over 2.6 million individuals.

Major hibernacula and maternity caves are known from Alabama, Missouri, Kentucky, Arkansas, and Tennessee. No hibernacula are known in Virginia. On the Jefferson National Forest there are no caves occupied by the gray bat at any time of the year. The gray bat is known to occur during the spring, summer and fall in five caves in three counties (Lee, Scott, Washington) in far southwest Virginia in the upper Tennessee River drainage. Four of these caves contain male transients or bachelors and numbers typically range from 4,000 to 8,000 with a high of approximately 20,000 in one cave in 1992. One maternity cave is known in Washington County and the numbers there increased from 1,084 in 1990 to 3,827 in 1992 (Linzey 1998). Individuals forage along rivers and shorelines up to 20 kilometers (about 12.5 miles) from their roosts (LaVal et al. 1977). It is possible the Forest provides some riparian foraging habitat along a few of the larger streams on the Clinch Ranger District or the southwest corner of the Mount Rogers NRA; however, it is likely that all foraging habitat in Virginia is on private land along large rivers and their immediate tributaries since no National Forest land managed by the Jefferson is within 12.5 stream miles of a known roost cave. The gray bat diet consists of flying insects with adult mayflies, caddisflies, dipterans, beetles and moths making up most of their food.

Direct and Indirect Effects

Forestwide standards under all alternatives relevant to the gray bat and its cave habitat would protect all caves that are discovered or purchased that support gray bats. Although no hibernacula or summer roost caves have been identified on the Forest, forest-wide standards maintain vegetation and require installation of gates or other protective structures at entrances of all caves occupied by populations of any threatened or endangered bats. Until a newly discovered cave has been surveyed for bats, it is assumed that federally listed bats are present and the cave and surrounding habitat is maintained for them until surveyed.

Effects on foraging habitat are expected to be beneficial since riparian corridors will be managed for the benefit of aquatic/riparian resources. The Forest has allocated 73,600 acres of riparian corridor along all perennial streams (1,053 miles) and all intermittent streams (1,970 miles). These acres will be managed under management prescription 11 (Riparian Area) under all alternatives, except F (the 1985 Forest Plan). The objective of this prescription is to retain, restore or enhance ecological processes and functions of these systems. The minimum forested corridor width provided for perennial streams, lakes and ponds is 100 feet on either side of the waterway. In addition, forest-wide direction provides that a minimum of 50% square feet/acre basal area of tree cover is retained within 25 feet each side along channeled ephemeral streams. These standards will not only provide forest cover for bat foraging and protection from predation, but will also ensure high water quality to support the aquatic insect prey base. Under Alternative F, this species is protected through Forestwide standards for TES.

Cumulative Effects

There are expected to be no cumulative effects to the gray bat resulting from implementation of any alternative. As stated above the caves where this species occurs are on private land not near the Forest. It is possible that individual gray bats may occasionally forage over National Forest land, but this is unlikely due to the distance Forest land is from occupied caves. Riparian vegetative conditions will be maintained based on standards associated with the Riparian Area management prescription. Insect populations (especially mayflies and other aquatic insects) will continue to be maintained so foraging will not be effected.

INDIANA BAT (***MYOTIS SODALIS***)

A Biological Assessment was written in April 1997 to analyze effects to the Indiana bat resulting from continued implementation of the George Washington and Jefferson National Forest Plans. Formal Consultation with the Annapolis Field Office of the U.S. Fish and Wildlife Service was requested on May 12, 1997 which included a request for incidental take. On September 16, 1997 a Biological Opinion was issued that included incidental take provisions along with Terms and Conditions and Conservation Recommendations. The Jefferson Forest Plan (along with the George Washington Forest Plan) was amended to include provisions resulting from that formal consultation. Information presented in the 1997 Biological Assessment and Biological Opinion is still pertinent to the Revised Jefferson Forest Plan, Environmental Impact Statement and are therefore incorporated by reference.

On March 11, 1967, the Indiana bat was listed as a federal endangered species under the Endangered Species Preservation Act (ESPA) of 1966. Species listed under ESPA carried over and became listed by the Endangered Species Act when it became law in 1973. A recovery plan for the species was completed on October 14, 1983. In October 1996, the Indiana Bat Recovery Team released a Technical Draft Indiana Bat Recovery Plan. In October 1997, a preliminary version entitled "Agency Draft of the Indiana Bat Recovery Plan," which incorporated changes from the 1996 Technical Draft, was released. Subsequently, an agency draft entitled "Indiana Bat (*Myotis sodalis*) Revised Recovery Plan" was distributed for comments in March 1999. A final revision is still in preparation. Critical habitat was designated for the species on September 24, 1976 and includes 11 caves and 2 abandoned mines in Illinois, Indiana, Kentucky, Missouri, Tennessee, and Hellhole Cave in Pendleton County, West Virginia. No critical is therefore on or near the Jefferson National Forest.

The distribution of Indiana bats is generally associated with limestone caves in the eastern U.S. (Menzel et al. 2001). Within this range, the bats occupy two distinct types of habitat. During winter, the Indiana bat hibernates in caves (and occasionally mines) referred to as hibernacula. Bats are often readily found and easily counted at this time. Census of hibernating Indiana bats is the most reliable method of tracking population trends range-wide. As such, winter distribution of the Indiana bat is well documented. Less is known about the abundance and distribution of the species during the summer maternity season, and even less is known about its migratory habits and associated range. During summer months, maternity colonies of more than 100 adult females roost under sloughing bark of

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dead and partially dead trees of many species, often in forested settings (Callahan et al. 1997). Reproductive females may require multiple alternate roost trees to fulfill summer habitat needs. Adults forage on winged insects within three miles of the occupied maternity roost. Swarming of both males and females and subsequent mating activity occurs at cave entrances prior to hibernation (MacGregor et al. 1999). During this autumn period, bats roost under sloughing bark and in cracks of dead, partially dead and live trees.

The U.S. Fish And Wildlife Service in 1999 reported the total population of Indiana bats at approximately 350,000 individuals, less than half the estimated population of 1960. The current population of Indiana bats is 382,350 individuals, which hibernate in 336 hibernacula (Clawson, 2001). The eight largest "Priority One" hibernacula (recorded population >30,000 since 1960) contain 198,000 Indiana bats, or 52 percent of the total known population. The 69 hibernacula classified as "Priority Two" (recorded population >500 but <30,000 bats since 1960) contain 171,000 Indiana bats, or 45 percent of the total known population (Rocky Hollow Cave is in this category). The remaining 259 caves known to have been occupied by Indiana bats contain only 14,000 bats, less than 4 percent of the total population (the other three hibernacula on or near the Forest – Kelly, Newberry-Bane, Patton, and Shires Saltpetre Caves - are in this category).

Large populations of Indiana bats hibernate in caves in Indiana, Kentucky, and Missouri (over 82% of the known population). They have also been found hibernating in abandoned mines and other man-made underground chambers. Smaller populations of hibernating Indiana bats are known from Alabama, Arkansas, Connecticut, Georgia, Illinois, Iowa, Maryland, Massachusetts, Michigan, Mississippi, New Hampshire, New Jersey, New York, North Carolina, Ohio, Oklahoma, Pennsylvania, South Carolina, Tennessee, Vermont, Virginia, West Virginia, and Wisconsin (USDI Fish And Wildlife Service, 1999). Although the winter range is large, the known population of the species has been found in only 336 hibernacula in an area with tens of thousands of caves (and mines).

Within 5 miles of the George Washington & Jefferson National Forest, eleven hibernacula for Indiana bats are known from 7 counties in Virginia (Bath, Bland, Craig, Highland, Lee, Tazewell, and Wise) and 1 county in West Virginia (Monroe). The Virginia Fish and Wildlife Information Service has additional historic records of Indiana bats wintering in Dickenson, Giles, Montgomery, and Shenandoah counties. Critical habitat for the Indiana bat has not been designated in Virginia. Currently, 8 of the 12 caves have been gated to reduce or eliminate human disturbance. All 12 caves continue to support varying numbers of Indiana bats.

The Indiana bat has been documented in southwestern Virginia since the mid-1960’s. In the early 1960’s, the state’s Indiana bat population was estimated at over 5,000. In 1997 the state’s population was estimated to be 1,840 bats. The Recovery Team (USDI Fish and Wildlife Service, 1999) considered the data from Virginia too sketchy for trend analysis. The 2000-2001 survey for hibernating Indiana bats in Virginia totaled 833 individuals, but the hibernaculum in Tazewell County was not surveyed that season. The entrance to this cave is dangerously unstable. The last survey in that cave was on January 21, 1999, and yielded 136 Indiana bats. The latest survey was conducted during the winter of 2002-2003. Data from that count has not yet been compiled but will be available by October 2003 (Rick Reynolds, VDGIF, pers. comm., 2003).

The 2000-2001 survey estimates the number of hibernating Indiana bats in Virginia at less than 1,000 individuals or approximately 0.2 percent of the total population. This represents an approximate 60 percent decline in the population since Dalton (1987) found 2,500 Indiana bats hibernating in eight caves during a 10-year survey of 170 caves in 22 counties.

Three of the five caves occur on or near the Jefferson National Forest that support hibernating Indiana bats are gated to control human access. Patton Cave and Newberry-Bane Cave are not gated but access is strictly controlled by the private landowners. The following table displays numbers of bats seen during winter survey counts conducted over the past 33 years. Numbers fluctuate from count-to-count but those caves that have lower numbers of bats seem to maintain low numbers while those with higher numbers maintain relative higher numbers of bats.

Steps have been taken by the Jefferson National Forest to protect these caves for the Indiana bat. In 1995, bat gates were installed in several caves on the Forest. These caves are Shires Saltpetre Cave on the New Castle Ranger District, and Kelly Cave and Cave Springs Cave on the Clinch Ranger District. Shires Saltpetre Cave and Kelly Cave are the only caves on National Forest land which serve as hibernacula for Indiana bats. Patton Cave, Rocky Hollow Cave and Newberry-Bane Cave are on private land but within 2-miles of Forest land. Therefore portions of the primary and/or secondary cave protection areas extend onto the Forest. Cave Springs Cave is not currently known to be a hibernaculum for any rare bat species (but it has the potential to serve as a hibernaculum) and is known to contain a variety of rare troglobitic amphipods and isopods.

Over the past several years Rick Reynolds of the Virginia Department of Game and Inland Fisheries has assisted the Jefferson National Forest in monitoring bats on the Forest during winter surveys and assisting with other studies.

It is difficult to quantify summer roosting habitat for Indiana bat at a range-wide, regional, or local level due to the variability of known roost sites and lack of knowledge about landscape scale habitat characteristics. Forest management practices that affect occupied roost trees may have local impacts on Indiana bat populations. However, the bats live in highly altered landscapes, depend on an ephemeral resource (dead and dying trees) and appear to be very adaptable. Anecdotal evidence suggests that these bats may respond positively to some degree of habitat disturbance (USDI Fish And Wildlife Service, 1999). General standards that would help ensure adequate roost habitat include retention of snags and suitable roost trees whenever possible, prescribed burning to restore and maintain uncluttered, open midstory foraging conditions (using only cool season backing fires in karst areas), and ensuring a continuous supply of oaks, hickories, and ash as well as other trees with exfoliating bark (Menzel et al. 2001).

During summer, reproductive females form maternity colonies in trees. Maternity colonies may be formed hundreds of miles from the hibernacula, and females from a maternity colony may come from more than one hibernaculum. In contrast, males often use wooded areas near the hibernaculum, occasionally visiting the hibernaculum throughout the summer, although some individuals may migrate long distances like females. Males sometime migrate long distances to summer habitat, although they tend to be less migratory than females, and often, though not always, remain geographically close to the hibernacula. During this time, males often roost individually, and likely use trees similar in character to those used near hibernacula in autumn and spring. They sometimes visit the hibernacula during summer. Wooded lands closer to hibernacula are more likely to support males in summer than areas farther away, but essentially all of the Jefferson National Forest may provide suitable summer habitat. Although most of the lands within the Forest provide suitable summer habitat for the Indiana bat, based on observations and field surveys, no juveniles or lactating females have been found. There is no evidence to date that maternity colonies occur in Virginia or within the Jefferson National Forest.

The core summer range of the Indiana bat is southern Iowa, northern Missouri, northern Illinois, northern Indiana, southern Michigan, and western Ohio. West Virginia is within the eastern maternity range, but not within the core range. West Virginia has no confirmed

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Indiana bat maternity colonies (USFS, 2001). The majority of known maternity colonies are in midwest states such as Ohio and Indiana. There are maternity colonies in some eastern states, such as Kentucky and North Carolina.

In West Virginia no maternity colonies, reproductive females, or juvenile Indiana bats have been caught during the summer reproductive season. However, in the summer of 1995, six male Indiana bats were captured in Tucker County. These captures represent the only documented summer use in West Virginia by Indiana bats and suggest that males in West Virginia use areas near the hibernacula during summer (Stihler, in press; USFS, 2001). To date the best evidence of maternity activity in West Virginia is the discovery of a juvenile male on August 5, 1999 (Kiser et al. 1999b). This is outside the defined maternity period and likely represents a juvenile migrating to a nearby hibernaculum.

Likewise, no maternity colonies or reproductive female Indiana bats have been captured in Virginia during the summer reproductive season. In summer 1992 and summer 1995, Chris Hobson of the Virginia Division of Natural Heritage surveyed areas of Bath, Bland, Highland, Lee, Tazewell, and Wise counties in proximity to known hibernacula. No female Indiana bats were captured and seven males were captured at five sites. One of the males, captured on July 28, 1992 in Cumberland Gap National Historic Park, Lee County, was a juvenile, suggesting that a maternity colony may be located in the Cumberland Gap area of Virginia, Kentucky, or Tennessee. These captures are the only documented summer Indiana bat occurrences in Virginia and suggest that males, at the least, use areas near the hibernacula during summer in western Virginia (Hobson, in prep).

Brack and others (in press) analyzed summer netting efforts 1995 to 2000 to identify summer reproductive populations in Virginia, West Virginia, and portions of Pennsylvania considered to be within the summer range of the Indiana bat. Over 3,000 net nights of effort failed to produce evidence of any maternity colonies.

The previous information covered winter and summer season activity. The following information covers autumn swarming, spring staging, and seasonal migratory movements.

Autumn swarming and spring staging typically occur in woodlands near the hibernacula with use of the hibernacula increasing as autumn progresses towards winter and decreasing as spring progresses towards summer. Little is known about the habitat used by either sex during migration, although it is generally presumed to include a variety of wooded habitats. The following is an excerpt from the USDI Fish And Wildlife Service (1999) Revised Draft Indiana Bat Recovery Plan:

"Although certain migration patterns may be inferred from limited band returns, they should be interpreted with caution. The sparse band recovery records, all of which are from the Midwest, indicate that females and some males migrate north in the spring upon emergence from hibernation (Hall, 1962; Barbour and Davis, 1969; LaVal and LaVal, 1980), although there is also evidence that movements may occur in other directions. However, summer habitats in the eastern and southern United States have not been well investigated; it is possible that both sexes of Indiana bats occur throughout these regions. Very little is known about Indiana bat summer habitat use in the southern and eastern United States, or how many Indiana bats may migrate to form maternity colonies there. Most summer captures of reproductively active Indiana bats (pregnant or lactating females or juveniles) have been made between April 15 and August 15 in areas generally north of the major cave areas. While these observations suggest that many or most female Indiana bats in the Midwest migrate north in the spring and south in the fall, potentially significant numbers also migrate in other directions."

When Indiana bats are captured in spring or autumn, especially when caught near a cave or mine, there is generally no way to determine why the bat was in the area. Indiana bats may use caves and mines during the non-maternity season (autumn through spring) for one or more reasons: 1) winter hibernation (and "preparation" for hibernation); 2) autumn swarming; 3) spring staging; and 4) vagrant or migratory use. Hibernacula tend to have higher use in spring and autumn, and larger winter concentrations typically produce greater spring and autumn use.

In West Virginia, a male juvenile caught on August 5, 1999 (Kiser et al. 1999b) was likely migrating to a nearby hibernaculum. As noted above, Indiana bats hibernating in mountainous regions of West Virginia may travel to warmer areas in the western part of the state or states to the west to raise their young. Brack and others (in press) indicated that nursery colonies were less likely in higher elevations and areas of cooler temperatures.

During a survey of coal mining operations in Wise County Virginia, a consulting firm documented use of an abandoned coalmine by a female Indiana bat on April 14, 2001 which may have been a migratory individual.

During autumn swarming and spring staging, Indiana bats use the cave hibernacula and nearby wooded habitats. In autumn, use of woodlands decreases over time as bats enter hibernation. The converse is true in spring. Two recent telemetry studies documented use of a variety of habitats within 2 miles of two caves on the Forest.

In late September 1999 four Indiana bats (3 males, 1 female) were trapped and fitted with radio transmitters at the entrance of Rocky Hollow Cave in Wise County. From September 23rd to October 13th (21 days) three roost trees were located (all on private land) that were used by two of the bats (one male and one female). The female used two different trees in open woodlands approximately 1.5 miles southwest of the cave near the Lonesome Pine Country Club. One was a shagbark hickory 19" DBH (diameter breast height) and the other was a yellow poplar with peeling bark next to a skid-road that had been damaged during a logging operation. The tree occupied by the male bat was used as a roost on multiple days and was a pignut hickory 27.9" DBH located 0.15 miles north of the cave. Other observations made during the course of the study included extensive foraging activity over hayfields and along edges of forests and fields.

During September and October of 2000 an extensive survey was made of fall swarming activity near Newberry-Bane Cave in Bland County, Virginia as part of the proposed American Electric Power (AEP) 765 kV Wyoming (WV) to Jacksons Ferry (VA) powerline project. This work was conducted by Virgil Brack of Environmental Solutions and Innovations, Cincinnati, Ohio and is documented in the Appendix to the Biological Assessment for the EIS associated with that project. Of 27 Indiana bats captured (24 males and 3 females) at the mouth of Newberry-Bane Cave, 17 (14 males and 3 females) were fitted with transmitters. Radio-tagged bats were monitored between September 9th and October 21st within 2-miles of the cave entrance.

Information gathered on foraging ecology found that Indiana bats most frequently used agricultural land (44.7%), intermediate deciduous forests (22.6%), and open deciduous forests (19.0%) habitats types, comprising 86.3% of all habitat types used for foraging during the survey. The bats' activity areas included proportionally more agricultural lands and open forests than was available in the study area. Closed canopy woodlands were not used by foraging bats to the extent they were available. The study concluded that Indiana bats more frequently used rights-of-way, pasture edges, savannah-like woods, and other openings rather than large, continuous tracts of closed canopy forests. These findings are consistent with the interpretation of telemetry data in similar studies.

For roosting ecology the study found a total of 26 roost trees for 8 of 17 bats fitted with transmitters. Of the 26 roost trees, 39% were shagbark hickories (*Carya ovata*) and 12 % northern red oak (*Quercus rubra*), for a total of 51%. Other tree species used as roosts included white oak (*Quercus alba*), red maple (*Acer rubrum*), sugar maple (*Acer saccharum*), black oak (*Quercus velutina*), bitternut hickory (*Carya cordiformis*), American basswood (*Tilia americana*), and yellow birch (*Betula alleghaniensis*). Five (19%) of the roost trees were dead snags. All roost trees were located in close proximity to the cave entrance ranging from 0.16 to 0.86 miles, with an average distance of 3,280 feet (0.6 miles). All roost trees were located near forest canopy openings such as open woodlands of pastures, scattered trees of recently logged areas, old logging roads, utility line corridors, and natural drainages. Five of the eight bats used the same roost tree for two to three consecutive days. Roosts were located in all types of deciduous forests, but exhibited a disproportional small use of mixed evergreen and deciduous forests. Roosts trees were very exposed with little or no canopy. It is likely that in doing so the bats were taking advantage of exposure to solar radiation in order to better regulate body temperature. Many open-canopy areas existed due to recent logging activity that left scattered trees within the harvested areas. Roosts in closed canopy deciduous forests were often in small openings near open corridor flyways.

While much of the activity observed during the study was close to the cave (within approximately 0.6 mile) bats also left the 2-mile study area all together. Males more so than females tended to range further from the cave. Perhaps they would leave to forage where there was less competition for prey (the caves in the area serve as hibernacula for over 8,000 individual bats of at least five different species) and return to the cave area periodically to mate. It's therefore likely roosting and foraging activity also occurred outside this 2-mile area but all documented roost trees and foraging behavior observed were within two miles of the Newberry-Bane cave.

Recent work in Missouri (Romme et al. 2002) and Kentucky (Kiser and Elliott 1996; and Gumbert 1996) have found that Indiana bats range up to 5 miles from hibernacula during autumn and spring swarming activity periods. Based on terrain and landscape characteristics of these areas (generally rolling without great vertical relief) when compared to the Ridge and Valley terrain of Virginia (mountainous with vertical relief 1,300 to 2,500 feet) it is likely Indiana bat activity in this portion of the Appalachians is confined to the valley in which the hibernacula occurs and may extend into adjacent valleys via gaps in the surrounding ridges or mountains. It is unlikely many bats will fly up more than a 1,000 vertical feet and over a mountain to forage in an adjacent valley, especially when these mountains are densely forested without many open corridors to serve as flyways.

The timing of spring and autumn migration has been generally inferred as the time between when bats leave the hibernacula and when they are found in maternity areas (spring), and visa-versa (autumn). In most portions of the range, this is generally considered to be from 15 April to 15 May in spring, and 15 August to 15 November in autumn, although these dates are sometimes adjusted regionally to accommodate latitudinal differences in season. Essentially all acres within the Jefferson National Forest could serve as potential migratory habitat for the Indiana bat.

Direct and Indirect Effects

Effects to the federally endangered Indiana bat (*Myotis sodalis*) were considered because it is assumed the entire Forest is potential habitat for this species. See USDI Fish and Wildlife Service's Biological Opinion (BO) of September 16, 1997 and the Forest's Environmental Assessment/Decision Notice of March 12, 1998 for the "Proposed Forest Plan Amendment for Management of the Federally Endangered Indiana Bat."

Potential habitat (mature forests with trees having exfoliating bark) exists across the entire Forest and contains tree species of the size and type known to be used by the Indiana bat. The retention of some snags, shagbark hickory, and hollow trees (as available) will allow for potential Indiana bat roost sites. Decreasing canopy closure as occurs with timbering and prescribed fire activities will increase the degree of exposure of some potential maternity roost trees to solar radiation, providing improved thermal conditions for raising young during a wide range of weather conditions. Pond/waterhole construction will increase the number of upland water sources available for Indiana bats. Persistence of early successional habitats and forests with an open understory and patchy overstory would create insect-rich foraging areas and flight corridors leading to any potential roost trees. Harvesting would produce a mosaic of regeneration areas intermixed with mature and late successional forests. Likewise prescribed fire would also create a mosaic of forest successional stages from early to late resulting from varying fire intensities associated with topographic features, vegetative types, and fuel accumulations. This will indirectly provide feeding areas since bats are known to forage within the canopy openings of upland forests, over clearings with early successional vegetation, and even along the borders of croplands, or wooded strips (fencerows), and over ponds. Contrastingly, negative impacts to the Indiana bat will be: (a) the slight chance that individuals or small groups of roosting bats (including summer maternity colonies) could be unintentionally killed by the intentional felling of trees harboring undetected roosts (e.g. dead limbs with loose bark, or small cavities in the boles), or by the accidental felling of occupied snags, or damaged or hollow trees during timber harvest or other activities; and (b) a short-term reduction in the total amount of foraging habitat available to individual Indiana bats which would be incurred on regeneration cuts. Although the likelihood is very low, tree cutting activities could result in the inadvertent loss of individual Indiana bats or small groups of Indiana bats, via removal of some large-diameter hardwood trees occupied by bats during the period from approximately April 1 to October 15.

Occupied and potential roost trees could be directly affected by vegetation management, firewood and salvage sales, routine maintenance/permitting of small clearings including easements, rights-of-way and access to privately-owned lands, and road construction. Plan implementation will result in vegetation disturbance and possible impact to currently occupied and potentially occupied roost trees. There is potential for adverse effects to a maternity roost tree if one occurs on the Forest and in an area where trees are being felled. However, forest-wide standards would minimize, if not eliminate, the chance of adverse effects under all alternatives.

Any Indiana bat roosts that are discovered would be protected from cutting and modification until they were no longer suitable (unless treatments were needed for public or employee safety) under all alternatives.

The National Forest fuelwood program allows the public to purchase and collect wood, often recently downed or standing/leaning dead trees, for personal use. The program is regulated by issuance of an area-specific permit and collection occurs primarily along roadsides and other specified sites with easy access. Vehicles must remain on open roads are not allowed to travel through the forest in order to find, cut, and load firewood. This therefore restricts the distance at which most people are willing to cut and haul firewood and results in firewood being cut within 150 feet (about two tree lengths) of an open road, and limited almost exclusively to level terrain or the uphill side. During 2001 and 2002, the Jefferson NF issued 510 and 466 (respectively) firewood permits, for an average of 488 permits over the two-year period. Each permit allows for the collection of 2 CCF (hundred cubic feet) of firewood (2 CCF roughly equals 1.5 cords of firewood). Therefore, 488 permits equal approximately 732 cords of firewood. A cord of firewood is a stack 4’ x 4’ x 8’ and contains 128 cubic feet or 1.28 CCF (hundred cubic feet). Based on yield tables from Firewood Volume Tables (Mize and Prestemon, 1998) a red oak 16” DBH

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(diameter breast height) and 60' tall contains approximately 0.50 cords of firewood, while a white oak the same diameter and height contains approximately 0.54 cords. Therefore, the 732 cords of firewood collected as an average during 2001 and 2002 equals approximately 1,464 dead trees (in this case red oak 16" DBH, 60' tall). The number of standing dead trees on the Jefferson can be calculated based on analysis of data collected during the 1991 Forest Inventory and Analysis conducted by the Southern Forest Research Station, Asheville, NC. (More recent data has been collected, but 1991 is the last year forest-wide data is available for the required analysis.) The number of dead standing trees at that time was 15.4 per acre with an average DBH of 9.0". Given that the Forest is approximately 723,000 acres, this equates to at least 11,134,200 dead standing snags.

The actual number of snags per acre is probably now much greater, and expected to continue to increase under all alternatives, than what was calculated for 1991. (See Biological Environment, Terrestrial Species and Their Habitats, Snags, Dens, and Downed Wood section of this EIS.) The northern portions of the Forest (Glenwood and New Castle Ranger Districts) have been infested with gypsy moths and pine bark beetle infestations are now forest-wide. The result of these insect infestations is extensive areas of oak and pine tree mortality in the overstory. Therefore, if 1,500 snags are cut each year for firewood, this equals to 0.0135% of the total available snags. Since most of these snags are not close to roads or are in Management Prescriptions where firewood cutting is not allowed, the possibility of harming an Indiana bat is extremely remote. Also it is not just snags that Indiana bats roost in, but also live trees. This is reflected in the Newberry-Bane study of fall swarming activity where 19% of the roost trees were snags and the remainder were live trees. The odds of encountering a roosting bat are even further reduced since only dead trees are available for cutting as firewood and these dead trees represent perhaps 20% of the trees where they roost. Although risk of "take" resulting from firewood cutting cannot be completely eliminated, the risk of direct effects to roosts in the vicinity of hibernacula is further minimized since the collection of firewood in primary and secondary cave protection areas (management prescriptions 8E1a and 8E1b) is not allowed by prescription standard. Some minimal risk of taking a bat roosting in a standing dead tree cut for firewood elsewhere on the Forest would continue to exist. However, given the relatively low number of Indiana bats on the Forest when compared to the number of acres, plus standing trees and snags, and that the use of any individual dead tree as a roost is very brief, the likelihood of take from firewood cutting is extremely small, if not non-existent under all alternatives.

Most types of timber harvest (salvage, even-aged, uneven-aged, etc.) activities would require some snag and potential roost tree retention plus specific retention of leave trees such as shagbark hickories. Forestwide standards in all alternatives, require in stand regeneration treatments greater than ten acres in size, a minimum average basal area of 15 square feet per acre of live trees is retained throughout the rotation, and priority is given to retaining the largest available trees that exhibit characteristics favored by roosting Indiana bats (sloughing bark, cracks and crevices).

Over the past several years the Forest has steadily increased its prescribed burn program. The level of prescribed burning by alternative is described in the Biological Environment, Wildland and Prescribed Fire section of this EIS. Alternative B would have the highest acres estimated to be prescribed fire each year, and consequently the most fireline, followed by Alternatives G, I, D, A, E, and F in order. Most of these burns will occur during the spring and early summer with some during the late winter and early fall. Control lines will consist of existing roads, trails, and streams wherever possible. In areas where control lines will need to be constructed they will be done with handtools and/or bulldozer. Lines will consist of a two to five foot wide strip dug to mineral soil. Some trees will need to be felled during line construction but in most cases larger trees will be avoided with the line going around and between the largest trees. Some standing trees and snags near the line will be felled which pose a hazard to personnel or may burn and fall across the line thereby spreading fire across the line and into areas not scheduled for burning. Purposes for the use of prescribed fire include ecosystem restoration, wildlife and rare species management, site preparation, and oak/pine regeneration. The 1997 Biological Opinion stated as a Conservation Recommendation that the Forest increase prescribed burning on lands unsuitable for timber harvest to maintain flight and foraging corridors in upland and riparian areas.

Cumulative Effects

Cumulatively, with implementation of any alternative, the Forest will maintain a supply of snags, live potential roost trees, upland water sources, and other habitat features across the landscape to allow for the maintenance, and promote the recovery, of Indiana bat populations. At the same time, activities can still continue to meet other multiple-use objectives. For example, timber harvesting can still occur to accomplish sufficient forest regeneration to provide diverse insect productions and provide for the continuation of diverse forest conditions across the Jefferson NF.

Overall, there will be both benefits and impacts to the Indiana bat from management activities on the Forest. From a beneficial standpoint, the retention of some snags, shag-bark hickory, and hollow trees in sale areas would allow potential Indiana bat roost sites to be conserved; the opening up of the canopy in sale areas and their margins would increase the degree of exposure of some potential maternity roost trees to solar radiation, providing improved thermal conditions for raising young; pond construction would increase the number of upland water sources available for Indiana bat. Slightly positive benefits for Indiana bat would result as harvested units create insect-rich foraging areas and flight corridors leading to any tree roosts that might be present there. Positive benefits would result from prescribed burning by decreasing understory vegetation density. Positive benefits will also be realized from the application of prescriptions and associated standards focused on protecting caves and managing vegetation structure and condition within 2-miles of hibernacula.

Contrastingly, negative impacts to the Indiana bat would be: (a) the slight chance that individuals or small groups of roosting bats (including summer maternity colonies) could be unintentionally killed by the intentional felling of trees harboring undetected roosts (e.g. dead limbs with loose bark, or small cavities in the boles), or by the accidental felling of occupied snags, or damaged or hollow trees during timber harvest or other activities; and (b) a short-term reduction in the total amount of foraging habitat available to individual Indiana bat which would be incurred on regeneration cuts. Although these bats will use small forest openings and edges as foraging habitat, they would be unlikely to utilize the central portions of harvested units during the early years of regeneration unless the residual basal area were unusually high. It is possible that the increased rate of insect production in the regeneration areas would make up for any loss of foraging habitat acreage, but such a determination would be difficult to make without extensive long-term research on the subject. The level of estimated timber harvest by type of silvicultural system for each alternative is discussed in the Social/Economic Environment, Timber Management section of this EIS. See specifically Table 3-169.

Although the likelihood is very low, implementation of any alternative may result in the inadvertent loss of individual Indiana bats or small groups of Indiana bats, via removal of some large-diameter hardwood trees occupied by bats during the period April 1 through October 15. This risk would be greatest in those alternatives with the highest acres of timber harvest. Alternative D has the highest acres estimated, followed by Alternatives F, A, B, I, E, and G in order.

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THREATENED, ENDANGERED, SENSITIVE AND LOCALLY RARE SPECIES

FEDERALLY LISTED THREATENED AND ENDANGERED TERRESTRIAL SPECIES

Under all alternatives, Forestwide and management prescription standards will provide adequate protection for summering and transitory Indiana bat individuals. These standards and prescriptions provide for maintenance of extensive forest areas that would remain undisturbed by most human processes that result from tree cutting. These areas are characterized by disturbance events where net losses and gains of potential roost trees would be dependent on ecological processes including tree mortality due to aging, insect and disease, lightning caused fires, and weather events.

In addition, all alternatives allocate areas surrounding known Indiana bat hibernacula to Management Prescription 8E4a and 8E4b. Two additional hibernacula were added between the Draft and Final EIS and Revised Land and Resource Management Plan. In the future, newly discovered hibernacula will be added through the Forest Plan amendment process.

In the 1997 USDI Fish And Wildlife Service's Biological Opinion, the Service determined that the level of anticipated take is not likely to result in jeopardy to the Indiana bat or destruction or adverse modification of any critical habitat.

Finally, this agency feels that there will be overall cumulative positive benefits for the Indiana bat. The agency believes that some level of harvesting on the Jefferson NF is necessary in order to manage, retain and perpetuate the existing forest types. It is within this diversity of these forest types that the Indiana bat has been able to survive over long periods of time, and has been able to maintain its numbers on the Forest in recent years. Although the loss of a few individuals from time to time during timber harvest is remotely possible, the overall large amount of improving roosting and foraging habitat for the Indiana bat, coupled with management activities taking bat life requirements into account, coupled with an increasing number of upland drinking water sources, and gating of hibernacula, suggests that these potential losses would be offset by overall future net gains in the population under all alternatives.

BALD EAGLE (*HALIAEETUS LEUCOCEPHALUS*)

The bald eagle ranges over most of the North American continent, from as far north as Alaska and Canada, down to Mexico. Experts believe that in 1782 when the bald eagle was adopted as the United States' national bird, their numbers may have ranged from 25,000 to 75,000 nesting pairs in the lower 48 states. Since that time the species has suffered from habitat destruction and degradation, illegal shooting, and most notably from contamination of its food source by the pesticide DDT. In the early 1960's, only 417 nesting pairs were found in the lower 48 states. In 1999, more than 5,748 nesting pairs of bald eagles were recorded for the same area, resulting primarily from the banning of DDT in the United States in 1972 aided by additional protection afforded under the Endangered Species Act (USDI Fish and Wildlife Service 1999b).

Bald eagles have few natural enemies but can be sensitive to human activity (i.e. boat traffic, pedestrians, or buildings), especially for nesting. Their breeding areas are generally close to (within 4 km) coastal areas, bays, rivers, lakes, or other bodies of water that reflect general availability of primary food sources including fish, waterfowl, rodents, reptiles, amphibians, seabirds, and carrion (Andrew and Mosher 1982, Green 1985, Campbell et al. 1990). Although nesting territory size is variable, it typically may encompass about 2.59 square kilometers (Abbott 1978). Most nest sites are found in large wooded areas adjacent to marshes, on farmland, or in logged-over areas where scattered seed trees remain (Andrew and Mosher 1982). Nests are constructed in large live trees (loblolly pine, Virginia pine, oak, tulip poplar, beech and hickory) with large limbs and open canopies providing a clear flight path to at least one side of the nest (Virginia Department of Game and Inland Fisheries 2003). The same nest may be used year after year, or birds may alternate between two nest sites in successive years. Bald eagles mate for life and are believed to live 30 years or more in the wild. In Virginia, nesting activity is observed from the months of November through June, with incubation of eggs typically in mid-January through March and nestlings April through June (Virginia Department of Game and Inland Fisheries 2003). Juvenile bald eagles do not reach sexual maturity until 4-6 years of age and during this time may disperse widely, though usually returning to nest within 150 km of where they were fledged (USDI Fish and Wildlife Service 1995). Bald eagles from the northern and southernmost parts of the species range are migratory. Adult breeding bald eagles in Virginia appear to be permanent residents, whereas the young disperse extensively northward and southward. Communal roosting sites and foraging areas are common for this species in summer and winter (USDI Fish and Wildlife Service 1995). Winter home ranges for eagles can be very large, especially for non-breeding birds. They winter throughout their breeding range but occur more frequently along the coast in communal roosts and foraging areas.

Primary threats to bald eagles include loss of nesting, foraging, and roosting habitat, especially along shorelines, disturbance by humans, biocide contamination, decreasing food supply, and illegal shooting (Byrd and Johnstone 1991, Buehler, D.A. et al. 1991).

Occurrence on the Jefferson National Forest:

The breeding range of bald eagles in Virginia historically and currently has largely been confined to the Chesapeake Bay and its tributaries in the Tidewater areas along the Atlantic coast (Virginia Department of Game and Inland Fisheries 2003, Trollinger and Reay 2001, and Kain 1987). The closest known nest site to the Forest is in Bath County about 50 miles to the northeast (Virginia Department of Game and Inland Fisheries 2003). Wintering populations are found on the Rappahannock, James and Potomac Rivers, with rare and transient sightings recorded in the mountain and piedmont regions of western Virginia (Virginia Department of Game and Inland Fisheries 2003). No known nesting sites or communal roosting or foraging sites have been documented on the Forest.

Direct and Indirect Effects

Vegetation management, road building, and prescribed burning activities have the potential to impact the bald eagle or its habitat, especially near rivers, lakes, or other wetlands. Human disturbance from recreational use of roads, trails, campgrounds and shoreline habitat can also adversely affect the use of an area for nesting or roosting by eagles. Levels of these types of activities by alternative are shown in other sections of Chapter 3 of this EIS.

Under all alternatives, except F (the 1985 Forest Plan), riparian standards in the Forest Plan, with emphasis on low levels of disturbance and maintenance of mature forest, would minimize potential adverse effects of vegetation management, road building and prescribed burning activities along riverine and lake habitat most suitable to bald eagles. Currently, there are no documented nest sites or communal roost or foraging sites of bald eagles on the Forest. If such sites are documented in the future, a forestwide standard for all alternatives, except F, would establish a 1500-foot radius protection zone around any bald eagle nest or communal roost site found on the Forest. Within this protection zone, vegetation management that would affect the forest canopy, or other activities that may disturb eagles, would be prohibited, during periods of eagle use. Under Alternative F, this species is protected through Forestwide standards for TES.

Since there are no known occurrences of bald eagles on the Forest, there are no direct effects to this species from management and recreational activities under any alternative.

BIOLOGICAL ENVIRONMENT

THREATENED, ENDANGERED, SENSITIVE AND LOCALLY RARE SPECIES

FEDERALLY LISTED THREATENED AND ENDANGERED TERRESTRIAL SPECIES

Cumulative Effects

Forested habitat on the Forest, especially along rivers, lakes and wetlands, is projected to continue maturing during the next ten to fifteen years, therefore increasing suitable nesting habitat for bald eagles during the planning period. There are no known occurrences of bald eagles nesting or communally roosting or foraging on the Forest. If bald eagles are documented on the Forest, standards are in place to provide protection from known threats due to management and recreational activities.

NORTHERN FLYING SQUIRREL (***GLAUCOMYS SABRINUS COLORATUS***)

The Carolina and Virginia subspecies of the northern flying squirrel were listed as Endangered under the ESA in 1985. A recovery plan was completed in September 1990 (USDI Fish and Wildlife Service 1990a). Since that time, nest box studies and live trapping efforts have been used to determine the presence or absence of this species within habitats considered suitable. Results of these efforts have shown the species to be scattered throughout remnant stands of spruce/fir and northern hardwood types in North Carolina, Virginia and Tennessee and also some areas with stands of northern hardwoods/hemlock. Some apparent core areas (areas of greater squirrel concentrations) have been determined. Conditions of the hardwood habitat component are improving for this species in most of its range due to the aging of the forests it prefers. The conifer component, especially Fraser fir (*Abies fraseri*), has declined dramatically. Although the red spruce component appears to be expanding its range into nearby northern hardwood stands in some areas of Virginia, it has also suffered some mortality due to recent epidemic southern pine beetle infestations at Roan and Unaka Mountains of Tennessee (Duerr 2002). In addition, the hemlock and balsam woolly adelgids are expected to cause significant loss of the hemlock and Fraser fir components in the future. The number of captured southern flying squirrels (*Glaucomys volans),* a species that may displace the northern flying squirrel, has also increased in some areas along with those of the northern flying squirrel.

The implementation schedule for the northern flying squirrel recovery plan (USDI Fish and Wildlife Service 1990a) includes several items that directly relate to management of national forests:

- Protect existing habitat (occupied & high potential of suitability);
- Survey potential habitat to locate additional populations;
- Monitor known populations;
- Monitor loss or degradation of high elevation forest resulting from insect damage and/or air pollution;
- Monitor the effects of modification or loss of habitat resulting from timber operations, roads, trails, or other recreation developments;
- Development of educational materials or programs about the species.

As a result of this survey and monitoring work, northern flying squirrel populations appear to be stable and possibly increasing within occupied habitats on the Mount Rogers National Recreation Area (NRA). Studies between 2000 – 2002 captured a total of 44 unique individuals from two sites. Recaptures during this period totaled 23 (Hackett, Pagels, Unpublished Data). Recent box checks on Whitetop Mountain in the spring of 2003 on a given day revealed 2 females, one with 3 young in the box and the other with two young plus another box with 1 adult male and 1 subadult male. In 2003 an additional study has revealed several captures within areas that have not been previously surveyed. Although we have increased our survey efforts substantially over the past three years, we have also documented more northern flying squirrels during this period than we previously thought existed (Thomas 2003).

Population estimates are not available, but the northern flying squirrel appears to be extremely rare throughout the southern Appalachians. These subspecies are also very difficult to capture and study. Northern flying squirrels may periodically abandon particular habitats or undergo periodic population oscillations making them undetectable for extended intervals (USDI Fish and Wildlife Service 1990a).

The distribution of northern flying squirrels is generally associated with high elevation boreal habitats, especially spruce/fir and northern hardwood forests within the Southern Appalachians. Each subspecies has a relict distribution of small and potentially vulnerable isolated populations that are separated by vast areas of unsuitable habitat. The subspecies *G. s. coloratus* is known from five isolated localities: three in the western mountains of North Carolina and two localities in the eastern mountains of Tennessee (USDI Fish and Wildlife Service 1991a). Populations of *G. sabrinus coloratus/fuscus* (subspecies taxonomy undetermined) are also known to occur in two counties in southwest Virginia (USDI Fish and Wildlife Service 1990a).

These subspecies occur primarily in the ecotone or vegetation transition zone, between coniferous and northern hardwood forests. Both forest types are used in search of food but the hardwood areas are needed for nesting (Weigl 1977). Northern flying squirrels have been shown to utilize deciduous hardwood and hardwood/hemlock habitats some distance away from spruce/fir stands (Weigl and Osgood 1974, Weigl 1978, Payne et al. 1989). On the Mount Rogers NRA these squirrels are commonly captured in conifer-hardwood ecotones or mosaics of red spruce, fraser fir, yellow birch, yellow buckeye, sugar maple, and beech. The occupied forest is generally a mixture of ages ranging from widely scattered old relicts down to relatively young trees less than 100 years of age. Understory vegetation varies from dense rhododendron thickets to relatively open woodlands dominated by ferns and grass. Red spruce and yellow birch appear to be the species that are always present within or immediately adjacent to all capture sites. Northern flying squirrel habitat use appears to be strongly associated with riparian areas as evidenced from the results of a recent telemetry study in the Mount Rogers/Whitetop areas (Thomas 2003).

Because of the flying squirrel's small size, the climatic severity of its habitat, and the abundance of avian and mammalian predators, secure nesting sites represent a critical limiting factor (USDI Fish and Wildlife Service 1990a). Recent information from studies in Virginia indicate that flying squirrels appear to select tree cavities, woodpecker holes in decadent snags, cavities under root wads, underground rock dens, and nest boxes where available during periods of cooler weather. (Hackett, H.M. and Pagels, J. F. 2002). Leaf nests in tree canopies are also used during warmer weather. Nest cavities are often found in yellow birch trees (*Betula allegheniensis*) and bark from this species is commonly used as nest material (Odom 1995). Studies conducted recently at Mount Rogers on 30 captured squirrels show preferred den sites as cavities (43%), leaf nests (33%), ground (20%) and other (3%) (Hackett, Pagels Unpublished data). Many of the cavities were in very small snags that were less than 8 inches dbh. Leaf nests are commonly used as summer dens.

Food availability and abundance may affect the distribution of G*. sabrinus ssp.* and the periodic dependence on certain species of fungi may be a factor in restricting the subspecies to high-elevation mesic habitats (USDI Fish and Wildlife Service 1990a). It is well documented that a substantial amount of the northern flying squirrel diet consists of wood-borne fungi (associated with spruce and, perhaps, other conifers) and lichens for food. They also consume seeds, buds, fruit, staminate cones, insects, and other animal material (USDI Fish and Wildlife Service 1990a).

BIOLOGICAL ENVIRONMENT

THREATENED, ENDANGERED, SENSITIVE AND LOCALLY RARE SPECIES

FEDERALLY LISTED THREATENED AND ENDANGERED TERRESTRIAL SPECIES

Direct and Indirect Effects

The northern flying squirrel is vulnerable to a number of both natural and human-related impacts. Habitat degradation or destruction from timber harvesting, grazing, road or trail construction, firewood gathering, air pollution, insects, wildfire, overuse from forest visitors, and the possibility of global warming could threaten this species and/or its habitat. Any activity that reduces the amount of spruce/fir forest, northern hardwood forest, or the hemlock/northern hardwood forest, or increases the oak component within northern hardwood stands may adversely affect northern flying squirrels.

Forest management activities that might affect the northern flying squirrel or its habitat are limited to prescribed burning, grazing, and dispersed recreation on the Mount Rogers NRA. These activities prevent the expansion of the spruce-fir habitat and thus prevent the possible expansion of the range of the northern flying squirrel. The most frequent use of these high elevation spruce/fir and northern hardwood forests is dispersed recreation, including activities such as hunting, hiking, and camping.

The objective to "Maintain stable and/or increasing population trends for the northern flying squirrel through protection, maintenance and restoration of high elevation spruce-fir and northern hardwood forest communities," is common to all alternatives.

Table 3-65. Acres of Spruce-Fir and Northern Hardwood Forest restoration outside of existing wilderness by Alternative

Alternative	Acres
A	17
B	3,094
D	702
E	17
F	17
G	3,329
I	1496

Alternatives G, B, D, and I would restore key spruce-fir and northern hardwood areas to provide linkages to connect suitable habitat types for northern flying squirrels. (See Table 3-65). This would be done through a combination of artificial plantings and natural protection of these areas. In addition, northern flying squirrel habitat is increasing naturally around the Mount Rogers/Whitetop areas within the Lewis Fork and Little Wilson Creek Wilderness Areas. Red spruce will become a significant component of designated and recommended wilderness areas over the next 200 years. Red spruce seedlings and saplings presently extend down to the 3,500 foot elevation levels on most of the north and east portions of these areas except on high quality sites where oak species and northern hardwoods are more competitive. Red spruce seedlings and saplings also extend down below 4,000 feet in elevation on most of the south side of the mountain including portions of the Little Wilson Creek Wilderness and much of the Grayson Highlands State Park. Many more mature Red spruce trees have reached competitive status, extending above the tree tops of other forest types (oaks primarily) and will become the climax forest type for most of these areas in the future under natural means.

Alternative G would cease all prescribed burning and livestock grazing activities in the Mount Rogers High Country, thereby restoring the maximum possible acreage of spruce-fir and northern hardwood forest through natural succession, approximately 3,330 acres outside wilderness. Alternative B would continue to maintain areas thought to be natural balds and restore the remaining to spruce-fir and northern hardwood forest through natural succession and planting, approximately 3,094 acres outside wilderness.

Alternatives A, E and F would continue prescribed burning and grazing to maintain the acres of high elevation meadows desired in the 1978 Mount Rogers NRA Final Management Plan, thereby negating the natural successional benefit to northern flying squirrel habitat, except for approximately 300 acres inside the existing wilderness areas and within riparian corridors. Alternatives A, E, and F would also actively restore 17 acres connecting Mount

Rogers and Cabin Ridge and a small area of Red Spruce at Whitetop.

In Alternative I, the Whitetop and Mount Rogers areas containing northern flying squirrel habitat have been allocated to special areas (management prescriptions 4K3 and 4K4). Both of these special areas are classified as unsuitable for timber management and management is primarily focused on managing forest visitor use, maintaining the outstanding vistas and natural scenery that led to designation of this area as a National Recreation Area, and protecting the high elevation rare communities and species that inhabit this area (including the spruce-fir and northern hardwood forest and northern flying squirrel). Road construction isnot allowed and motorized access is limited to currently existing roads. Approximately 1,500 acres outside wilderness of both natural and active spruce-fir and northern hardwood forest restoration is anticipated under Alternative I.

The spruce-fir community is also identified as a rare community (management prescription 9F) in all alternatives except F (the 1985 Forest Plan). In all alternatives, vegetation management is limited within 0.5-mile of habitat occupied by the northern flying squirrel. Trail construction and firewood gathering could occur within these forest types after appropriate project-level affects analysis results in a “no effect” determination. Activities that affect vegetation would not directly affect the northern flying squirrel because they would not be allowed within the 0.5-mile protection area around occupied habitat.

Riparian corridors (management prescription 11) are designed in all alternatives except F (the 1985 Forest Plan) to not only minimize adverse impacts to aquatic and riparian areas, but to maintain them as healthy, functioning systems to benefit riparian species including the northern flying squirrel. High elevation riparian areas are reverting to spruce through natural restoration in significant quantities. Major riparian areas include Little Wilson Creek, Big Wilson Creek, Cabin Creek, Middle Fork Helton Creek, Opossum Creek and their tributaries. Regardless of alternative, the use of prescribed fires of low intensity is not hampering the spread of red spruce seedlings within these damp riparian areas. Here presently expanding young vegetation will provide connective corridors for species such as the northern flying squirrel within the next 100+ years.

Cumulative Effects

Grayson Highlands State Park has significant acreage of forested land that is presently undergoing natural restoration with increasing amounts of red spruce within northern hardwoods as previously described on National Forest lands. Furthermore, they are not actively maintaining their bald areas, thus allowing them to revert to red spruce and northern hardwoods through natural means. Additional significant acreage of spruce-fir and northern hardwood habitat known to be beneficial to the northern flying squirrel will become available for occupation by this species in the future.

Habitat on the Forest currently occupied by the northern flying squirrel is protected and habitat linkages are being restored both naturally, and through planting and fire exclusion. This will provide corridors for the northern flying squirrel, and other species, and allow gene flow and occupation of additional habitat over the next several years. Therefore the cumulative effects of all alternatives will be beneficial.

FEDERALLY LISTED THREATENED AND ENDANGERED AQUATIC SPECIES

The Southeastern United States supports the greatest diversity of freshwater mussel species in the world (Parmalee and Bogan 1998), and the richest freshwater fish fauna in North America north of Mexico (Warren et al. 2000). A large number of these species occur on or near the Forest, including many that are federally threatened or endangered. In fact, the upper Clinch River contains more imperiled species than any other watershed in the United

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THREATENED, ENDANGERED, SENSITIVE AND LOCALLY RARE SPECIES

FEDERALLY LISTED THREATENED AND ENDANGERED TERRESTRIAL SPECIES

States (Stein et al. 2000). See Appendix B for percent (%) of federal ownership by various watersheds.

Direct and Indirect Effects

Management actions most likely to create adverse effects to aquatic species are those that expose mineral soil, potentially leading to sedimentation, and those that reduce vegetative cover near streams, potentially leading to increased water temperature and decreased input of leaf litter and large wood.

Timber harvesting can directly affect sediment transport in streams if it increases (or decreases) the supply of sediment, if it alters the peak flow or the frequency of high flows, and if it changes the structure of the channel by removing the supply of large woody debris that forms sediment storage sites. Bank erosion and lateral channel migration also contribute sediments if protective vegetation and living root systems are removed.

The use and construction of roads, log landings, trails, and other ground disturbing activities could increase the amount of erosion during periods of high flow. Sediment loading in streams affects the aquatic fauna directly and indirectly. Direct effects include damage to gills and body surface by abrasion by suspended particles. Indirect effects come from a reduction in available dissolved oxygen, a reduction in suitable habitat due to substrate being covered with sediment, a reduction in pool volume, and the filling of interstitial spaces. These all affect habitat quality and complexity.

If a forested riparian corridor were not left along the streams in a project area, reduction of streamside canopy could affect the physical characteristics of the stream channel and can also affect food quality and quantity for macroinvertebrates and other stream organisms directly and indirectly. Direct effects occur by changing the input of particulate food (leaf litter). Indirect effects come from alteration of the structure and productivity of the microbial food web through increased sunlight and modifying the levels of dissolved organic carbon and nutrients. Indirect effects of canopy removal may include increases in stream temperature. A 2-5^{o} C warming of small streams can affect life history characteristics of macroinvertebrates and developmental time of fish eggs (Sweeney 1993).

Impoundments can alter flow regimes by changing the timing and quantity of instream flow below the reservoir. A decrease in water volume can lead to changes in channel morphology, and an increase in water temperature. Increased flow below an impoundment can lead to channel scour and flow levels that disrupt the reproductive cycle of aquatic organisms. For example, high flows could wash away glochidia or juvenile mussels. Impoundments also affect dissolved and particulate organic matter in the water column, and can change the natural temperature regime of a downstream river reach. These changes can affect the available food for aquatic organisms and create unsuitable thermal habitat. River habitat above an impoundment ultimately changes from a lotic to a lentic system. Impoundments, as well as poorly designed road and trail stream crossings, can block fish passage thereby isolating upstream populations.

The potential impacts addressed above will be negligible since, under all alternatives, except F (the 1985 Forest Plan), the riparian corridor desired future condition is for predominantly forested conditions and management is primarily for riparian resources. An additional function of this corridor is to stabilize the streambank, to moderate water temperature and promote the growth of desirable algae via shading, to provide soil/water contact area for biogeochemical processing of nutrients, and to contribute necessary organic detritus and large woody debris to the stream ecosystem. Protection of federally listed aquatic species and their critical habitat will be achieved through Forestwide and Riparian Corridor standards under all alternatives, except F. In addition, a proactive approach will be taken to not only protect riparian ecosystems, but to restore degraded areas where appropriate, and to assist state and federal agencies with recovery efforts. Under Alternative F, federally listed aquatic species are protected through Forestwide standards for TES

Cumulative Effects

A cumulative effects analysis should consider incremental impacts of actions when added to past, present, and reasonably foreseeable future actions. The analysis should include all actions regardless of who undertakes them. Cumulative impacts can result from individually minor but collectively significant actions taking place over time. For this document, cumulative effects were analyzed through a two-part watershed analysis, which included resource assessment and management prescription (Reid 1998).

Throughout the planning process, the Forest evaluated watersheds using information including, but not limited to: Virginia Department of Environmental Quality 303(d) report for impaired waters (VA DEQ 2003); Virginia Department of Environmental Quality and Virginia Department of Conservation and Recreation 305(b) report on non-point source pollution (VA DEQ and DCR 2003); Virginia Department of Game and Inland Fisheries collection records; Virginia Division of Natural Resources collection records and reports; local knowledge of forest recovery from past conditions; local knowledge of current watershed problems; macroinvertebrate, stream habitat, and water chemistry information; and geographic information system layers of land use, point source, road and strip mine locations. Through this resource assessment, the Forest evaluated cumulative watershed effects associated with land use practices at the 5th Hydrologic Unit Code (HUC) watershed level, and their effect on aquatic fauna and habitat. The federally listed aquatic species by 5th HUC level and the percent of Forest ownership in that watershed are listed in Appendix B.

Concurrently, the Forest carried out an interdisciplinary analysis looking at interactions between resources with a goal of managing riparian corridors to retain, restore, and /or enhance the inherent ecological processes and functions of the associated aquatic, riparian, and upland components within the corridor, while minimizing effects to aquatic and riparian resources from other activities. This was done through many meetings and discussions, which included not only multi-agency resource professionals, but members of the public as well. From this work, prescriptions, goals, objectives, and standards were developed in order to focus management on riparian, aquatic, and healthy watershed needs. This is documented in Chapter 4 of the Revised Forest Plan, the identification of Priority Watersheds (Revised Forest Plan Table 2-1), and the development of Management Prescriptions 9A1 (Source Water Protection), 9A2 (Reference Watersheds), 9A3 (Watershed Restoration Areas), 9A4 (Aquatic Habitat Areas) and 11 (Riparian Corridors). They were designed to not only minimize adverse impacts to aquatic and riparian areas, but to maintain them as healthy, functioning systems. With the exception of Alternative F (the 1985 Forest Plan), these goals, objectives, standards, and protective management prescriptions are the same across all alternatives.

Although acerages within 9A1, 9A2, and 9A4 do vary by alternative, this is largely due to other equally protective management prescriptions applying in one alternative versus another. For example, Alternative G has the most acres of recommended wilderness and backcountry prescriptions, therefore, it has fewer acres of 9A1, 9A2, and 9A4. Acres of 9A3 Watershed Restoration Areas, in contrast, do vary by alternative with Alternative B having 8,800 acres, Alternative G 8,200 acres, Alternative I 1,700 acres, and Alternatives A, D, and E having 300 acres.

Resulting from the careful development of prescriptions and standards, there should be beneficial effects on in-stream uses (including federally listed aquatic species) during the implementation of any of the alternatives. Alternative F has adequate streamside management zones and Forestwide standards for protecting aquatic species, although it does not have the same level of protection as the other alternatives. For Alternatives A, B, D, E, G, and I, these beneficial effects include, but are not limited to: watershed restoration activities, road and recreation site maintenance, reconstruction, relocation, and/or closure/ rehabilitation; and control and management of livestock grazing will reduce sediment that is currently entering the stream system. Buffer zone filter strips will limit sediment produced by ground disturbing activities (including road construction, firelines, trails, livestock grazing, wildlife habitat improvements, prescribed and wildland fire, recreation development, and timber harvest) from entering a stream system. Management of Federal leasable minerals according to standard lease terms, additional stipulations, surface use plan of operations, as well as Federal and State laws governing both private and Federal mineral development will limit sediment and other pollutants from entering a stream system. Management of streamside areas for riparian purposes and needs will increase large woody debris and shade. Stream crossings of roads and trails will allow the passage of desired aquatic organisms. The Revised Forest Plan, under all alternatives except F, contains an objective to quantify and maintain instream flow needs to protect aquatic organisms when new water use authorizations are proposed.

Any effects from management activities will be insignificant or discountable and therefore, there will be no adverse cumulative watershed effects to the federally listed aquatic species addressed in this document or their critical habitat. For those aquatic species addressed that do not occur on the Forest, the main avenues for the Forest to aid in these species' recovery are through educating and working with landowners to protect streams and streamside habitat, and assisting efforts to identify additional suitable habitat and restore these species to historical habitats as appropriate. In some cases, acquisition of lands within the Forest's Proclamation Boundary will also be part of recovery actions.

The following pages will provide specifics for each federally-listed fish and mussel. Discussion of Forestwide standards and Riparian Prescription standards are applicable to all alternatives, except F. As already mentioned, Alternative F contains Forestwide standards that that protect water quality and individual aquatic species.

FEDERALLY LISTED THREATENED AND ENDANGERED AQUATIC SPECIES

Of all the factors contributing to the jeopardized status of Southeastern native freshwater fishes, non-point source pollution (primarily siltation) and alteration of flow regimes (primarily impoundment) are the largest contributors to fish imperilment. Etnier (1997) points out that these two anthropogenic factors are responsible for 72% of imperilment problems, while 23% is the result of the non-anthropogenic factor of a small native range. The remaining 5% contribution toward jeopardizing Southeastern fish is divided between the introduction of non-native invasives, point-source pollution, overzealous collectors, and unknown factors.

Fish

DUSKYTAIL DARTER (***ETHEOSTOMA PERCNURUM***)

The duskytail darter was federally listed as endangered in 1993 (USDI Fish and Wildlife Service 1994b). The species is endemic to the upper Tennessee and Cumberland River systems. There are four extant populations: three in Tennessee and one in Virginia. The Virginia population is in Copper Creek and Clinch River in Scott County, greater than five miles downstream from the Forest.

This species is found in rocky areas with moderate to fast current in large creeks and large rivers. Slab rocks, free from sediment, are essential for nesting as well as hiding cover. The eggs are attached to the under side of the slab rock and the male remains with the nest guarding the eggs. Food items include midge larvae, mayfly nymphs, and micro-crustaceans. Sight feeding is probably important.

Table 3-66. Overview of duskytail darter occurrences and habitat on and near the JNF

River Basin	Watersheds	Miles On	Miles Near	Counties of Occurrence	Role[1]
Clinch	Copper Creek and Clinch River	0	6-8	Scott	Protect and Manage

[1] Protect = provide suitable water quality since they are downstream; Manage= Manage riparian habitat and protect water quality on the Forest.

Direct, Indirect, and Cumulative Effects

The decline and extirpation of most populations of duskytail darters is attributed to the general deterioration of water quality resulting from siltation from logging, mining, and waste discharges. The relict populations are isolated by reservoirs. Because of its limited range this species is vulnerable to catastrophic events such as accidental toxic chemical spills. For populations of duskytail darters near the Forest, potential management influences include: sedimentation, mineral development, and altered flow. Forest-wide and riparian standards will protect the duskytail darter and its habitat from sediment released during management activities and mineral development. Instream flow needs will be quantified and maintained to protect aquatic organisms when new water use authorizations are proposed.

BLACKSIDE DACE (***PHOXINUS CUMBERLANDENSIS***)

The blackside dace was listed as threatened in 1987. Historically, the blackside dace likely inhabited many of the small, moderate gradient cool water streams in the upper Cumberland River system in Kentucky and Tennessee. The range of this species has decreased to approximately 35 stream stretches. The species is found on the Forest in the Poor Fork of the Cumberland River, Kentucky. In addition, blackside dace specimens collected earlier from Cox Creek were confirmed in 2001. This is significant, since Cox Creek is a tributary to the North Fork of the Powell River making this the first record within the Tennessee drainage (Hylton, R. 2002). Since then, it has been collected from other areas in the North Fork Powell system. These new occurrences are adjacent to the Forest, and it is expected that nearby tributaries also contain blackside dace. Genetics work conducted on the Tennessee drainage blackside dace populations concluded that they are recent introductions of this fish, probably by bait bucket (Hylton, R. 2002).

Table 3-67. Overview of blackside dace occurrences and habitat on and near the JNF

River Basin	Watersheds	Miles On	Miles Near	Counties of Occurrence	Role[1]
Cumberland	Poor Fork Cumberland	1	0	Harlan	Protect and Manage
Tennessee	N. Fork Powell tributaries	0	2?	Lee	Protect and Manage

[1] Protect = provide suitable water quality since they are downstream; Manage= Manage riparian habitat and protect water quality on the Forest.

Blackside dace inhabit cool, small, upland streams with moderate flow. The fish is generally associated with undercut banks and large rocks, and it is usually found within well-vegetated watersheds with intact riparian areas. Blackside dace feed on algae, diatoms, and small invertebrates. Spawning occurs in May over the nests of other fish in gravel run areas.

Direct, Indirect, and Cumulative Effects

The decline of this species is linked to siltation from coal mining and other ground disturbing activities, water quality degradation including acid mine drainage, impoundments, and residential development. Competition with the introduced southern redbelly dace (Phoxinus erythrogaster) may have displaced blackside dace from the warmer waters within its range. For populations of blackside dace on or near the Forest, the potential management influences include: sedimentation, mineral development, and altered flow. The Surface Mining Control and Reclamation Act of 1977 prohibits surface (strip) mining of coal on the Forest. Residential development is prohibited on the Forest. Forest-wide and riparian standards will protect the blackside dace and its habitat from sediment released during management activities and mineral development. Instream flow needs will be quantified and maintained to protect aquatic organisms when new water use authorizations are proposed.

The Forest will manage and protect populations and historical habitats of blackside dace. Protection and active management will be implemented where the species is on, or historically occurred on, the Forest. Protection, monitoring, and augmentation will be the primary recovery objectives. Actions will be taken in order to identify additional suitable habitat and restore fish to areas on the Forest where appropriate.

ROANOKE LOGPERCH (*PERCINA REX*)

The Roanoke logperch was federally listed as endangered in 1989. It is confined to the Roanoke and Chowan drainages of Virginia; the populations are small and separated by many river miles of unoccupied habitat or large impoundments. In the Valley and Ridge Province (nearest the Forest), P. rex is contiguously distributed in the upper Roanoke River and its lower North and South forks, and is known from lower Mason and Tinker creeks. This species is rare or uncommon, with the largest population in the upper Roanoke River from Roanoke city into the lower reach of its main forks (Jenkins and Burkhead 1994). Although this fish is not known to occur on the Forest, it is found approximately 2-3 miles downstream from the Forest boundary.

This species inhabits medium-sized streams that are warm, usually clear, and have moderate to low gradient. Young and small juveniles usually occupy slow runs and pools, most frequently sandy areas. During warmer months, adults typically dwell on gravel and rubble in riffles, runs, and pools (Jenkins and Burkhead 1994).

Table 3-68. Overview of Roanoke logperch occurrences and habitat on and near the JNF

River Basin	Watersheds	Miles On	Miles Near	Counties of Occurrence	Role[1]
Roanoke	N. and S. Fork Roanoke	0	2-3	Roanoke, Montgomery	Protect and Manage

[1] Protect = provide suitable water quality since they are downstream; Manage= Manage riparian habitat and protect water quality on the Forest.

Direct, Indirect, and Cumulative Effects

The USDI Fish and Wildlife Service (1992a) stated:

The largest and most vigorous population, in the upper Roanoke River, is subject to the most serious threats: urbanization, industrial development, water supply and flood control projects, and agricultural runoff in the upper basin.

For populations of Roanoke logperch near the Forest, potential management influences are sedimentation altered flows. Forest-wide and riparian standards will protect the Roanoke logperch and its habitat from sediment released during management activities. Instream flow needs will be quantified and maintained to protect aquatic organisms when new water use authorizations are proposed.

SLENDER CHUB (***ERIMYSTAX CAHNI***)

The slender chub was listed as a threatened species in 1977. Critical habitat is designated as: Powell River main channel from the backwaters of Norris Lake in Tennessee, upstream through Lee County, Virginia; and Clinch River from the backwaters of Norris Lake upstream through Scott County, Virginia.

This species is endemic to the upper Tennessee River system in Tennessee and Virginia. Historically, the species is known from 3 rivers in the drainage, the Clinch, Powell, and Holston Rivers. The slender chub is thought to be extirpated from the Holston River but is still known in low numbers from the Clinch River greater than 5 miles downstream from the Forest, and the Powell River about 10 miles downstream from the Forest.

The slender chub is a large river species and it is restricted to moderately to fast flowing flats and shoals composed of pea-sized gravel. Slender chubs occasionally occupy slow runs but have never been found in backwater or pool habitat. The species feeds on aquatic insect larvae and small mollusks. Spawning is thought to occur in the spring.

Table 3-69. Overview of Slender chub occurrences and habitat on and near the JNF

River Basin	Watersheds	Miles On	Miles Near	Counties of Occurrence	Role[1]
Powell	Powell	0	10	Lee	Protect and Manage

[1] Protect = provide suitable water quality since they are downstream; Manage= Manage riparian habitat and protect water quality on the Forest.

Direct, Indirect, and Cumulative Effects

Siltation, dredging, pollution, water withdrawal, and impoundment are threats to the habitat of the slender chub. The pea-size gravel substrate utilized by the fish is particularly vulnerable to destruction by siltation. Coal fines are a problem in the Powell River. For populations of slender chub near the Forest, the potential management influences are sedimentation, mineral development, and altered flows. Forest-wide and riparian standards will protect the slender chub and its habitat from sediment released during management activities and mineral development. Instream flow needs will be quantified and maintained to protect aquatic organisms when new water use authorizations are proposed.

BIOLOGICAL ENVIRONMENT

THREATENED, ENDANGERED, SENSITIVE AND LOCALLY RARE SPECIES

FEDERALLY LISTED THREATENED AND ENDANGERED AQUATIC SPECIES

SPOTFIN CHUB (*CYPRINELLA MONACHA*)

The spotfin chub was federally listed as threatened in 1977. The species is endemic to the Tennessee River system, where it was widely distributed in major tributaries. There are four extant populations: Little Tennessee River (NC), Duck River (TN), Emory River (TN), and North Fork of the Holston River (VA). The Virginia population is approximately 10 miles downstream from National Forest land in Scott, Smyth, and Washington Counties, VA. There were historic populations in the Middle Fork Holston River (USDI Fish and Wildlife Service 1983e).

This species is found in medium to large sized streams with slow to swift current over various substrates. Spawning occurs from mid-May to August. Feeding occurs diurnally and includes aquatic invertebrates. Sight and taste stimuli are used to locate food.

Table 3-70. Overview of spotfin chub occurrences and habitat on and near the JNF

River Basin	Watersheds	Miles On	Miles Near	Counties of Occurrence	Role[1]
Holston	N. Fork Holston	0	10 +	Scott, Washington	Protect and Manage

[1] Protect = provide suitable water quality since they are downstream; Manage= Manage riparian habitat and protect water quality on the Forest.

Direct, Indirect, and Cumulative Effects

Forest-wide and riparian standards will protect the spotfin chub and its habitat from sediment released during management activities. Instream flow needs will be quantified and maintained to protect aquatic organisms when new water use authorizations are proposed.

YELLOWFIN MADTOM (*NOTURUS FLAVIPINNIS*)

The yellowfin madtom was federally listed as threatened in 1977. The species is endemic to the Tennessee River system up stream of Chattanooga, Tennessee. There are three extant populations: 1) Citico Creek in Monroe County, Tennessee on the Cherokee National Forest; 2) Powell River in Hancock County, Tennessee; and 3) Copper Creek in Scott and Russell Counties, Virginia. They were historically known from the North Fork Holston River downstream of the Forest. The population in Copper Creek is near, but not within, a watershed where the Forest manages land, thus this evaluation does not include this population, only the unoccupied habitat of the North Fork of the Holston River (USDI Fish and Wildlife Service 1983f).

Table 3-71. Overview of yellowfin madtom occurrences and habitat on and near the JNF

River Basin	Watersheds	Miles On	Miles Near	Counties of Occurrence	Role[1]
Clinch	Copper Creek	0	5+	Scott, Russell	Protect and Manage

[1] Protect = provide suitable water quality since they are downstream; Manage= Manage riparian habitat and protect water quality on the Forest.

This species is found in small to medium sized streams with moderate current free of sedimentation. Cover, especially flat slab rocks, is essential for nesting as well as hiding. The eggs are laid in a clutch under the slab rock and guarded by the male. Feeding usually occurs at night. Food includes aquatic invertebrates. Sight, tactile and chemical stimuli are used to locate food.

Direct, Indirect, and Cumulative Effects

The decline and extirpation of most populations of yellowfin madtoms is attributed to pollution and siltation from logging, mining, agriculture and construction. The greatest threat to the Citico Creek population is an accidental chemical spill that could destroy the entire population. Two other significant threats are sedimentation from ground disturbing activities (especially vehicles, horses, and people compacting and denuding the stream banks); and habitat destruction from recreational swimmers who pile slab rocks in the streams to create dams with deep pools. These pools are not quality habitat for this species, and the slab rocks are essential to yellowfin madtoms for spawning and cover. All of the yellowfin madtom populations are isolated from the each other by reservoirs.

Forest-wide and riparian standards will protect the yellowfin madtom and its habitat from sediment released during management activities, as well as effects related to mineral development, and recreational activities.

MUSSELS

Recent assessments of North America’s mussel fauna recommended conservation status for 67 to 75 percent of the species (Master et al. 1998, Watters 2000). No other wide-ranging animal group in North America is undergoing such a high degree of imperilment. Thirty-seven species are presumed or possibly extinct and 69 species are federally listed as threatened or endangered (Stein et al. 2000). The adverse modification and destruction of aquatic habitats, water pollution, and the introduction of non-indigenous species, have been the major causes of mussel declines and extinctions during this century (Stein et al. 2000).

APPALACHIAN MONKEYFACE (***QUADRULA SPARSA***)

The Appalachian monkeyface was federally listed as endangered in 1976 (USDI Fish and Wildlife Service 1983a). The following distribution information comes from NatureServe (2002):

Historically thought to have been widespread in the tributaries of the upper Tennessee and Cumberland River systems. Distributional records became confused when Ortmann lumped Q. sparsa and Q. tuberosa under Q. intermedia (Bogan and Parmalee, 1983). Previously restricted to free-flowing reaches of the Powell and Clinch rivers above Norris Reservoir in Tennessee (USDI Fish and Wildlife Service, 1984) and in one section of the Powell and Clinch Rivers in Virginia in Lee and Scott Counties (Neves 1991).

A new population of this species was found at Cleveland Island in the Clinch River, Russell County, Virginia (Pinder, M. 2003). This species occurs less than 5 miles downstream from the Forest.

The Appalachian monkeyface has been found inhabiting a sand and gravel substrate in riffles and shallow shoal areas with moderate current (Parmalee and Bogan 1998). Fish hosts are unknown.

BIOLOGICAL ENVIRONMENT

THREATENED, ENDANGERED, SENSITIVE AND LOCALLY RARE SPECIES

FEDERALLY LISTED THREATENED AND ENDANGERED AQUATIC SPECIES

Table 3-72. Overview of Appalachian monkeyface occurrences and habitat on and near the JNF

River Basin	Watersheds	Miles		Counties of Occurrence	Role[1]
		On	Near		
Tennessee	Powell and Clinch Rivers	0	5	Lee, Scott	Protect and Manage

[1] Protect = provide suitable water quality since they are downstream; Manage= Manage riparian habitat and protect water quality on the Forest.

Direct, Indirect, and Cumulative Effects

Threats to the Appalachian monkeyface include impoundments, siltation and pollution (NatureServe 2002).

The decline and extirpation of most populations of the Appalachian monkeyface may be due to habitat modification, sedimentation, eutrophication, and other forms of water quality degradation. Restricted movement of host fish may also be a factor in the decline of this species. For populations of the Appalachian monkeyface on or near the Forest potential management influences include: sedimentation, altered flow, and blockage of host fish passage associated with roads and crossings. Forest-wide and riparian standards will protect the Appalachian monkeyface and its habitat from sediment released during management activities. Instream flow needs will be quantified and maintained to protect aquatic organisms when new water use authorizations are proposed.

TAN RIFFLESHELL (*EPIOBLASMA FLORENTINA WALKERI*)

The tan riffleshell mussel was federally listed as endangered in 1977. The species was widely distributed in the Cumberland and Tennessee River systems but there are now only two extant populations in Virginia: 1) in the Middle Fork of the Holston River (Smyth and Washington Counties, Virginia) greater than 10 miles downstream from the Forest; and 2) in Indian Creek, Tazewell County (USDI Fish and Wildlife Service. 1984c).

This species is found in small to moderate sized rivers in riffles with coarse substrates. Water willow is often present. Habitat conditions also need to meet the requirements of sculpins and greenside, fantail, snubnose, and redline darters which may serve as the host for the glochidia. Freshwater mussels are filter feeders taking organic detritus, diatoms, phytoplankton, and zooplankton from the water column. Mussels require clean gravel riffles and are especially susceptible to low dissolved oxygen levels or high chlorine concentrations. Furthermore, this mussel requires waters of low turbidity to attract potential host fish to the glochidia.

Table 3-73. Overview of Tan riffleshell occurrences and habitat on and near the National Forest

River Basin	Watersheds	Miles		Counties of Occurrence	Role[1]
		On	Near		
Tennessee	Middle Fork and S. Fork Holston, Clinch	0	20	Smyth, Washington, Tazewell	Protect and Manage

[1] Protect = provide suitable water quality since they are downstream; Manage= Manage riparian habitat and protect water quality on the Forest.

Direct, Indirect, and Cumulative Effects

The decline and extirpation of most populations of tan riffleshell mussels may be due to dam construction and impoundments. Siltation from logging, mining, agriculture and construction; organic and inorganic pollutants from industrial, agricultural, and other point and non-point sources; and habitat loss due to channelization and dredging have negatively affected the surviving populations. For populations of the tan riffleshell downstream from the Forest, potential management influences include: sedimentation, altered flow, and blockage of host fish passage associated with roads and crossings. Forest-wide and riparian standards will protect the tan riffleshell and its habitat from sediment released during management activities and mineral development. Instream flow needs will be quantified and maintained to protect aquatic organisms when new water use authorizations are proposed.

CUMBERLAND BEAN (*VILLOSA TRABALIS*)

The Cumberland bean was federally listed as endangered in 1976. The species is endemic to the tributary streams of the Tennessee and Cumberland River systems. There are four extant populations. Three are in the tributaries to the middle Cumberland River: 1) the Little South Fork River; 2) Buck Creek; and 3) Rockcastle River. The fourth population is in the Hiwassee River in Polk County, Tennessee on the Cherokee National Forest (USDI Fish and Wildlife Service. 1984b).

This mussel was formerly known from streams in the upper Tennessee drainage in Virginia, specifically the Clinch River, but is now thought to be extinct from Virginia.

This species is found in large streams and small rivers in fast current with gravel or sand and gravel substrate. Fish hosts include: arrow darter, barcreek darter, fantail darter, Johnny darter, rainbow darter, snubnose darter, sooty darter, striped darter, and stripetail darter. Freshwater mussels are filter feeders taking organic detritus, diatoms, phytoplankton, and zooplankton from the water column. Mussels require clean gravel riffles and are especially susceptible to low dissolved oxygen levels or high chlorine concentrations. Furthermore, this mussel requires waters with low turbidity to attract potential host fish to the glochidia.

Table 3-74. Overview of Cumberland bean occurrences and habitat on and near the JNF

River Basin	Watersheds	Miles		Counties of Occurrence	Role[1]
		On	Near		
Tennessee	Clinch (Thought to be extinct in VA)	N/A	N/A		Protect and Manage

[1] Protect = provide suitable water quality since they are downstream; Manage= Manage riparian habitat and protect water quality on the Forest.

Direct, Indirect, and Cumulative Effects

The decline and extirpation of most populations of Cumberland bean may be attributed to dam construction and impoundments. Siltation from logging, mining, agriculture and construction; organic and inorganic pollutants from industrial, agricultural, and other point and non-point sources; and habitat loss do to channelization and dredging have degraded the habitat for the surviving populations.

BIOLOGICAL ENVIRONMENT

THREATENED, ENDANGERED, SENSITIVE AND LOCALLY RARE SPECIES

FEDERALLY LISTED THREATENED AND ENDANGERED AQUATIC SPECIES

For historic habitat of the Cumberland bean downstream from the Forest, potential management influences include: sedimentation, altered flow, and blockage of host fish passage associated with roads and crossings. Forest-wide and riparian standards will protect habitat from sediment released during management activities and mineral development. Instream flow needs will be quantified and maintained to protect aquatic organisms when new water use authorizations are proposed.

BIRDWING PEARLYMUSSEL (*LEMIOX RIMOSUS*)

The birdwing pearlymussel was federally listed as endangered in 1976. Distribution information used in this analysis is from NatureServe (accessed 2002):

The birdwing pearlymussel is currently known from the Clinch, Powell, Copper Creek, Elk, and Duck Rivers in Tennessee and Virginia. Historically, it was known throughout Tennessee River drainage, but absent from Cumberland River (Terwilliger 1991).

This species is found about 1 mile downstream from the Forest in the Clinch River.

The birdwing pearlymussel is a riffle-dwelling species that usually occurs in moderate to fast flowing water of shallow to moderate (6 feet) depth. It resides in stable, silt-free substrates of mixed particle size ranging from sand to cobble. Fish hosts include the banded darter and greenside darter (Parmalee and Bogan 1998), and possibly the mirror shiner, spotfin shiner, and whitetail shiner (USDI Fish and Wildlife Service 1983b).

Table 3-75. Overview of birdwing pearlymussel occurrences and habitat on and near the JNF

River Basin	Watersheds	Miles		Counties of Occurrence	Role[1]
		On	Near		
Tennessee	Powell and Clinch Rivers, Copper Creek	0	1	Lee, Russell	Protect and Manage

[1] Protect = provide suitable water quality since they are downstream; Manage= Manage riparian habitat and protect water quality on the Forest.

Direct, Indirect, and Cumulative Effects

Threats to the birdwing pearlymussel include pollution, habitat alteration impoundments, siltation from mining, channelization, and the introduced Asian clam. (NatureServe 2002).

The decline and extirpation of most populations of the birdwing pearlymussel may be attributed to habitat modification, sedimentation, eutrophication, and other forms of water quality degradation. Restricted movement of host fish may also be a factor in the decline of this species. For populations of the birdwing pearlymussel on or near the Forest, potential management influences include: sedimentation, altered flow, and blockage of host fish passage associated with roads and crossings. Forest-wide and riparian standards will protect the birdwing pearlymussel and its habitat from sediment released during management activities and mineral development. Instream flow needs will be quantified and maintained to protect aquatic organisms when new water use authorizations are proposed. Prior to the stocking of any non-native species, the national forest coordinates with the appropriate State agencies to ensure populations and habitats of native species are maintained.

CRACKING PEARLYMUSSEL (*HEMISTENA LATA*)

The cracking pearlymussel was federally listed as endangered in 1991. Distribution information used in this analysis is from NatureServe (accessed 2002):

The cracking pearlymussel originally inhabited the Ohio, Cumberland, and Tennessee River systems. It has been extirpated from most of its former range but some viable populations may persist in the upper Clinch River in Tennessee (Parmalee and Bogan 1998).

This mussel is currently found in the Clinch and Powell Rivers in Virginia, approximately 1 mile downstream of the Forest.

The cracking pearlymussel is a riffle-dwelling species, occurring at fords and shoals with sand and gravel substrates and moderate current velocities. It can burrow deep into the river bottom because of an unusually long foot and is, therefore, difficult to collect. It usually occurs in less than two feet of water and spends most of its life deeply buried in substrate (Parmalee and Bogan 1998). Fish hosts are the rock bass, banded sculpin, whitetail shiner, central stoneroller, streamline chub, striped shiner, margined madtom, greenside darter, and bluebreast darter (Jones and Neves 2000).

Table 3-76. Overview of cracking pearlymussel occurrences and habitat on and near the JNF

River Basin	Watersheds	Miles On	Miles Near	Counties of Occurrence	Role[1]
Tennessee	Clinch and Powell Rivers	0	1+	Scott, Lee	Protect and Manage

[1] Protect = provide suitable water quality since they are downstream; Manage= Manage riparian habitat and protect water quality on the Forest.

Direct, Indirect, and Cumulative Effects

Threats to the cracking pearlymussel include impoundments, siltation and pollution, inadequate sewage treatment, coal mining, and oil and gas drilling. (NatureServe 2002).

The decline and extirpation of most populations of the cracking pearlymussel may be attributed to habitat modification, sedimentation, eutrophication, and other forms of water quality degradation. Restricted movement of host fish may also be a factor in the decline of this species. For populations of the cracking pearlymussel near the Forest potential management influences include: sedimentation, altered flow, and blockage of host fish passage associated with roads and crossings. Forest-wide and riparian standards will protect the cracking pearlymussel and its habitat from sediment released during management activities and mineral development. Instream flow needs will be quantified and maintained to protect aquatic organisms when new water use authorizations are proposed.

CUMBERLANDIAN COMBSHELL (*EPIOBLASMA BREVIDENS*)

The Cumberlandian combshell was federally listed as endangered in 1997. Distribution information used in this analysis is from NatureServe (accessed 2002):

Historically, distributed throughout the Cumberlandian region of the Tennessee and Cumberland River systems. Populations are currently known from Buck Creek in Kentucky; through a few miles of the Big South Fork Cumberland River in Kentucky and Tennessee; and in very low numbers in the Powell and Clinch Rivers in Virginia and Tennessee (USDI Fish and Wildlife Service 1997). A few, likely non-reproducing, populations associated with sub-lotic sections of some reservoirs (e.g., Old Hickory Reservoir on the Cumberland River). In 1997 several fresh dead specimens were found by Jeff Garner in Bear Creek, a tributary of the Tennessee River in northwestern Alabama and according to Tom Mann (Mississippi Natural Heritage Program) fresh dead shells were found in Mississippi in September 2000.

Habitat near the Forest includes the Clinch and Powell Rivers. It is greater then 5 miles downstream from National Forest land.

The Cumberlandian combshell has been collected in about two feet of water on a sand and gravel substrate in the Clinch River. Other reports indicate this species is found in moderate sized, clear streams with rocky bottoms. It appears to be absent in the smaller tributaries (Parmalee and Bogan 1998). Fish hosts are the banded sculpin, greenside darter, logperch, redline darter, spotted darter, Tennessee snubnose darter, and the wounded darter.

Table 3-77. Overview of Cumberlandian combshell occurrences and habitat on and near the JNF

River Basin	Watersheds	Miles		Counties of Occurrence	Role[1]
		On	Near		
Tennessee	Clinch and Powell Rivers, N. Fork Holston	0	5+	Lee, Scott	Protect and Manage

[1] Protect = provide suitable water quality since they are downstream; Manage= Manage riparian habitat and protect water quality on the Forest.

Direct, Indirect, and Cumulative Effects

Threats to the Cumberlandian combshell include impoundments, channelization, siltation, and pollution (USDI Fish and Wildlife Service 1998b). NatureServe (2002) states: "Much of its former habitat has been inundated by reservoirs and considerable other portions have been devastated by acid mine run-off. Various forms of pollution and poor land use practices (e.g. siltation) threaten survival of remaining EOs [element occurrences]."

The decline and extirpation of most populations of the Cumberlandian combshell may be attributed to habitat modification, sedimentation, eutrophication, and other forms of water quality degradation. Restricted movement of host fish may also be a factor in the decline of this species. For populations of the Cumberlandian combshell on or near the Forest potential management influences include: sedimentation, altered flow, and blockage of host fish passage associated with roads and crossings. Forest-wide and riparian standards will protect the Cumberlandian combshell and its habitat from sediment released during management activities and mineral development. Instream flow needs will be quantified and maintained to protect aquatic organisms when new water use authorizations are proposed.

DROMEDARY PEARLYMUSSEL (***DROMUS DROMAS***)

The dromedary pearlymussel was federally listed as endangered in 1976. NatureServe (accessed 2002) describes the historic and current distribution of this species:

Known from the Cumberland and Tennessee River systems in Tennessee and Virginia. Once common throughout the Tennessee River system, it is currently known from the middle Cumberland River in Smith County, Tennessee; the Tennessee River in Meigs County, Tennessee; and in the upper Powell and Clinch rivers in Tennessee and Virginia (Parmalee and Bogan 1998).

It is found in the Clinch and Powell Rivers greater than 10 miles downstream from National Forest land.

The dromedary pearlymussel has been collected in the upper Powell and Clinch Rivers in shoals and riffles on gravel and sand substrates in about three feet of water (Parmalee and Bogan 1998). A possible fish host is the gilt darter.

Table 3-78. Overview of dromedary pearlymussel occurrences and habitat on and near the JNF

River Basin	Watersheds	Miles On	Miles Near	Counties of Occurrence	Role[1]
Cumberland	Poor Fork Cumberland	1	0	Harlan	Protect and Manage

[1] Protect = provide suitable water quality since they are downstream; Manage= Manage riparian habitat and protect water quality on the Forest.

Direct, Indirect, and Cumulative Effects

Threats to the dromedary pearlymussel are not clearly understood, but probably include impoundments, siltation, and pollution (USDI Fish and Wildlife Service 1983c). NatureServe (accessed 2002) lists the following as threats to this species: impoundments, siltation and pollution leading to water quality and habitat deterioration, inadequate sewage treatment, coal mining, oil and gas drilling.

The decline and extirpation of most populations of the dromedary pearlymussel may be attributed to habitat modification, sedimentation, eutrophication, and other forms of water quality degradation Restricted movement of host fish may also be a factor in the decline of this species. For populations of the dromedary pearlymussel on or near the Forest potential management influences include: sedimentation, altered flow, and blockage of host fish passage associated with roads and crossings. Forest-wide and riparian standards will protect the dromedary pearlymussel and its habitat from sediment released during management activities and mineral development. Instream flow needs will be quantified and maintained to protect aquatic organisms when new water use authorizations are proposed.

FANSHELL (*CYPROGENIA STEGARIA*)

The fanshell was federally listed as endangered in 1990. The following is from NatureServe (accessed 2002) regarding the distribution of the fanshell:

It was historically widely distributed in the Tennessee, Cumberland, and Ohio River systems, although it has become very rare in recent years. In the Ohio drainage it has been recently found in: the deep channel of the Ohio River between Cincinnati and Pittsburgh (Johnson, 1980); the lower Muskingum and Walhonding Rivers, Ohio (Stansbery, et al. 1982); the Salt and Licking Rivers, tributaries of the Ohio (Stansbery, pers. comm.); the Green River, Kentucky (Biggins, 1991) the Kanawha River, West Virginia (Stansbery, pers. comm.); the Allegheny River, Pennsylvania (Dennis, 1970); and the lower Clinch River in Scott County (Neves 1991).

This species occurs greater than 5 miles downstream from the Forest in the Clinch River.

This species is considered a big river species, but may inhabit shallow, unimpounded upper reaches of the Clinch River (Parmalee and Bogan 1998). Fish hosts are unknown.

Table 3-79. Overview of fanshell occurrences and habitat on and near the JNF

River Basin	Watersheds	Miles On	Miles Near	Counties of Occurrence	Role[1]
Clinch	Clinch	0	5+	Scott	Protect and Manage

[1] Protect = provide suitable water quality since they are downstream; Manage= Manage riparian habitat and protect water quality on the Forest.

Direct, Indirect, and Cumulative Effects

Threats to the fanshell include impoundments, navigation projects, pollution, and habitat alterations, such as gravel and sand dredging. These activities directly affect the species and/or reduce or eliminate its fish host (USDI Fish and Wildlife Service 1991b).

The decline and extirpation of most populations of the fanshell may be attributed to habitat modification, sedimentation, eutrophication, and other forms of water quality degradation. Restricted movement of host fish may also be a factor in the decline of this species. For populations of the fanshell on or near the Forest potential management influences include: sedimentation, altered flow, and blockage of host fish passage associated with roads and crossings. Forest-wide and riparian standards will protect the fanshell and its habitat from sediment released during management activities and mineral development. Instream flow needs will be quantified and maintained to protect aquatic organisms when new water use authorizations are proposed.

FINE-RAYED PIGTOE PEARLYMUSSEL (*FUSCONAIA CUNEOLUS*)

The fine-rayed pigtoe pearlymussel was federally listed as endangered in 1976. Distribution information from NatureServe (accessed 2002):

This mussel was historically widespread in tributaries of the Tennessee River system in Tennessee (above the Muscle Shoals area), Virginia, and Alabama. It currently persists in portions of the Clinch and Powell rivers, the North Fork of the Holston, and in the Paint

Rock River. The largest population resides in the Clinch River but it is reproductively isolated from the Powell River population (Neves 1991).

This species occurs within a mile of the Forest in the Clinch River. Other Virginia occurrences include the North Fork Holston River, the Powell River, Copper Creek, and Little River.

The fine-rayed pigtoe pearlymussel is typically found in riffles in ford and shoal areas of rivers with moderate gradient (Parmalee and Bogan 1998). Fish hosts are the central stoneroller, fathead minnow, mottled sculpin, river chub, telescope shiner, Tennessee shiner, white shiner, and whitetail shiner.

Table 3-80. Overview of fine-rayed pigtoe pearlymussel occurrences and habitat on and near the JNF

River Basin	Watersheds	Miles On	Miles Near	Counties of Occurrence	Role[1]
Tennessee	N. Fork Holston, Clinch and Powell Rivers, Copper Creek, Little River	0	1+	Tazewell, Scott, Lee	Protect and Manage

[1] Protect = provide suitable water quality since they are downstream; Manage= Manage riparian habitat and protect water quality on the Forest.

Direct, Indirect, and Cumulative Effects

Threats to the fine-rayed pigtoe pearlymussel include impoundments, channelization, siltation, and pollution (USDI Fish and Wildlife Service 1984a). NatureServe (accessed 2002) states that this species:

“Has declined due to impoundments, siltation, and pollution. The remnant population in the Powell River may be threatened by oil and gas drilling and coal mining (Neves, 1991). The Clinch River population was reduced by toxic discharges and spills prior to 1972. The invasion of the Asian clam, and the possible invasion of the zebra mussel, also threatens remaining populations.”

The decline and extirpation of most populations of the fine-rayed pigtoe pearlymussel may be attributed to habitat modification, sedimentation, eutrophication, and other forms of water quality degradation. Restricted movement of host fish may also be a factor in the decline of this species. For populations of the fine-rayed pigtoe pearlymussel on or near the Forest potential management influences include: sedimentation, altered flow, and blockage of host fish passage associated with roads and crossings. Forest-wide and riparian standards will protect the fine-rayed pigtoe pearlymussel and its habitat from sediment released during management activities and mineral development. Instream flow needs will be quantified and maintained to protect aquatic organisms when new water use authorizations are proposed. Prior to the stocking of any non-native species, the national forest coordinates with the appropriate State agencies to ensure populations and habitats of native species are maintained.

GREEN-BLOSSOM PEARLYMUSSEL (***EPIOBLASMA TORULOSA GUBERNACULUM***)

The green-blossom pearlymussel was federally listed as endangered in 1976. This subspecies has been extirpated throughout its range and is possibly extinct. A live individual was last observed in 1984 in the Clinch River. Repeated visits to the site have

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produced only relicts. The only remaining subspecies of E. torulosa is E. torulosa ranging found in the upper Ohio drainage (NatureServe 2002).

Distribution information used in this analysis is from NatureServe (accessed 2002):

This subspecies is the headwater form of E. torulosa that once inhabited the larger rivers of the Interior Basin. Ortmann reported it from the Tennessee, Nolichucky, Holston, Clinch and Powell Rivers.

The green-blossom pearlymussel was found in riffle areas with swift currents on a substrate of coarse sand and gravel to a substrate of firmly packed fine gravel, typically in shallow water. It has been collected in water varying from a few inches to six feet (Parmalee and Bogan 1998). Fish hosts are unknown.

Table 3-81. Overview of green-blossom pearlymussel occurrences and habitat on and near the JNF

River Basin	Watersheds	Miles		Counties of Occurrence	Role[1]
		On	Near		
Clinch	N. Fork Holston, Clinch River (Thought to be extinct)	N/A	N/A		Protect and Manage

[1] Protect = provide suitable water quality since they are downstream; Manage= Manage riparian habitat and protect water quality on the Forest.

Direct, Indirect, and Cumulative Effects

Threats to the green-blossom pearlymussel include impoundments, channelization, siltation, and pollution (USDI Fish and Wildlife Service 1983d).

The decline and extirpation of most populations of the green-blossom pearlymussel may be attributed to habitat modification, sedimentation, eutrophication, and other forms of water quality degradation. Restricted movement of host fish may also be a factor in the decline of this species. For populations of the green-blossom pearlymussel on or near the Forest potential management influences include: sedimentation, altered flow, and blockage of host fish passage associated with roads and crossings. Forest-wide and riparian standards will protect the green-blossom pearlymussel and its habitat from sediment released during management activities and mineral development. Instream flow needs will be quantified and maintained to protect aquatic organisms when new water use authorizations are proposed.

JAMES SPINYMUSSEL (*PLEUROBEMA COLLINA*)

The James spinymussel was federally listed as endangered in 1988 (USDI Fish and Wildlife Service 1990b). Historically, this species was apparently throughout the James River above Richmond, in the Rivanna River, and in ecologically suitable areas in all the major upstream tributaries (Clarke and Neves 1984). The species remained widespread through the mid-1960's, but now appears extirpated from 90% of the historic range.

Occurrences of the James spinymussel near the Forest include Potts Creek, Craig Creek, Johns Creek, and, there are historic records from the James River.

This species is found in slow to moderate currents over stable sand and cobble substrates with or without boulders, pebbles, or silt (Clarke and Neves 1984). Hove and Neves (1994) found James spinymussels in 1.5 to 20 m wide second and third order streams at water depths of 0.3 to 2 m. Seven fish hosts, all in the family Cyprinidae, have been identified (Hove 1990): bluehead chub, rosyside dace, blacknose dace, mountain redbelly dace, rosefin shiner, satinfin shiner, and stoneroller. Freshwater mussels are filter feeders taking organic detritus, diatoms, phytoplankton, and zooplankton from the water column.

Table 3-82. Overview of James spinymussel occurrences and habitat on and near the JNF

River Basin	Watersheds	Miles On	Miles Near	Counties of Occurrence	Role[1]
James	Craig Creek, Potts Creek	1	1	Craig, Botetourt, Giles	Protect and Manage

[1] Protect = provide suitable water quality since they are downstream; Manage= Manage riparian habitat and protect water quality on the Forest.

Direct, Indirect, and Cumulative Effects

The following excerpt from Hove and Neves (1994) states the current thinking on threats:

"There are several anthropogenic and natural threats to the James spinymussel's continued existence. Nearly all the riparian lands bordering streams with the James spinymussel are privately owned. With more intensive use of the land, it is probable that water quality and habitat suitability will deteriorate. At present, the most detrimental activities include road construction, cattle grazing, and feed lots that often introduce excessive silt and nutrients into the stream."

The introduced Asian clam is also considered to be a threat to the James spinymussel and is beginning to invade several sites (Hove and Neves 1994).

Despite extensive searches on the Forest, the James spinymussel has been confirmed at only one site. This consisted on one live specimen found in 1990 (O'Connell and Neves 1991). A subsequent survey in 2001 (Kirk, D. and F. Huber. 2001) failed to locate any live specimens at this site. It is uncertain whether the Forest supports a viable population of James spinymussel. The main avenues for the Forest to aid in this species recovery are through land acquisition, assisting in augmentation efforts, and working with landowners to protect streams and streamside habitat.

The decline and extirpation of most populations of the James spinymussel may be attributed to habitat modification, sedimentation, eutrophication, and other forms of water quality degradation. Restricted movement of host fish may also be a factor in the decline of this species. For populations of the James spinymussel on or near the Forest potential management influences include: sedimentation, altered flow, and blockage of host fish passage associated with roads and crossings. Forest-wide and riparian standards will protect the James spinymussel and its habitat from sediment released during management activities. Instream flow needs will be quantified and maintained to protect aquatic organisms when new water use authorizations are proposed. Areas designated as management prescription 9A4 are unsuitable for new dams unless negative effects to threatened, endangered, sensitive, or locally rare aquatic species can be mitigated. Prior to the stocking of any non-native species, the national forest coordinates with the appropriate State agencies to ensure populations and habitats of native species are

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maintained.

The Forest will manage and protect extant populations and historical habitats of the James spinymussel. Protection and active management will be implemented where the species is physically on, or historically occurred on Forest lands. Protection, monitoring, and augmentation will be the primary recovery objectives. Actions will be taken in order to identify additional suitable habitat and restore fish hosts and mussels to areas on Forest lands.

Recovery objectives will include annual or bi-annual monitoring of representative populations by qualified biologists for populations trend and habitat quality. Monitoring will include either search indices or transects depending on local conditions and mussel densities. Inventories of additional potential habitat will also be conducted.

LITTLE-WING PEARLYMUSSEL (***PEGIAS FABULA***)

The little-wing pearlymussel was federally listed as endangered in 1988. Historically, this species occurred in many of the moderately high gradient, small to medium tributaries of the Tennessee and Cumberland Rivers systems in Alabama, Kentucky, Tennessee, North Carolina, and Virginia. Currently this species is only now known from Kentucky, Tennessee, and Virginia (USDI Fish and Wildlife Service 1989). Several sites are known from Virginia: North Fork Holston River, Washington and Smyth County, Middle Fork Holston River, Smyth County, Big Mocassin and Copper Creeks, Scott County. Occurrences are within 2 miles of National Forest.

This species is typically found in cool, clear high gradient streams. Located on top of, or partially embedded in, sand and fine gravel between cobbles in 6 to 10 inches of water, often at the head of riffles (Parmalee and Bogan 1998). Possible fish hosts are greenside darter, emerald darter, banded sculpin and redline darter.

Table 3-83. Overview of little-wing pearlymussel occurrences and habitat on or near the JNF

River Basin	Watersheds	Miles		Counties of Occurrence	Role[1]
		On	Near		
Cumberland	Poor Fork Cumberland	1	0	Harlan	Protect and Manage

[1] Protect = provide suitable water quality since they are downstream; Manage= Manage riparian habitat and protect water quality on the Forest.

Direct, Indirect, and Cumulative Effects

Threats to the little-wing pearlymussel are coal mining, and gas and oil development in the upper Cumberland and Powell River basins. Additional impacts have been caused by reservoir construction, poor land use practices, and urbanization that have caused excessive siltation and pollution throughout the species range (USDI Fish and Wildlife Service 1989).

The decline and extirpation of most populations of the little-wing pearlymussel may be attributed to habitat modification, sedimentation, eutrophication, and other forms of water quality degradation. Restricted movement of host fish may also be a factor in the decline of this species. For populations of the little-wing pearlymussel on or near the Forest potential management influences include: sedimentation, altered flow, and blockage of host fish passage associated with roads and crossings. Forest-wide and riparian standards will protect the little-wing pearlymussel and its habitat from sediment released during management activities and mineral development. Instream flow needs will be quantified and maintained to protect aquatic organisms when new water use authorizations are proposed.

OYSTER MUSSEL (*EPIOBLASMA CAPSAEFORMIS*)

The oyster mussel was federally listed as endangered in 1997. Distribution information used in this analysis is from NatureServe (accessed 2002):

Historically, this species was distributed throughout the Cumberlandian region of the Tennessee and Cumberland River drainages in Alabama, Kentucky, Tennessee, and Virginia. Currently, in the Cumberland River drainage, remnant populations are found in Buck Creek and the Big South Fork Cumberland River in Kentucky and Tennessee. In the Tennessee River drainage, remnant populations are scattered through sections of the upper Clinch and Powell rivers in Tennessee and Virginia (within five miles of the Forest), and the Duck River in Tennessee. Although it has not been seen in recent years in the lower Nolichucky and Little Pigeon rivers in Tennessee it may still persist in low numbers (USDI Fish and Wildlife Service 1997). It is believed to be extirpated from Alabama and potentially from Copper Creek in Virginia (Fraley and Ahlstedt 1999).

The oyster mussel has been found in shallow riffles in fast water less than three feet in depth on gravel and sand substrates. Fish hosts are the banded sculpin, dusky darter, redline darter, spotted darter, and the wounded darter.

Table 3-84. Overview of Oyster mussel occurrences and habitat on and near the JNF

River Basin	Watersheds	Miles		Counties of Occurrence	Role[1]
		On	Near		
Tennessee	Clinch, Powell, N. Fork Holston, Little River, Copper Creek	0	5	Tazewell, Russell, Wise, Scott, Lee	Protect and Manage

[1] Protect = provide suitable water quality since they are downstream; Manage= Manage riparian habitat and protect water quality on the Forest.

Direct, Indirect, and Cumulative Effects

Threats to the oyster mussel include impoundments, channelization, siltation, and pollution (USDI Fish and Wildlife Service 1998b). NatureServe (2002) states: “Much of its former habitat has been inundated by reservoirs and considerable other portions have been devastated by acid mine run-off. Various forms of pollution and poor land use practices (e.g., siltation) threaten survival of remaining EOs [element occurrences].”

The decline and extirpation of most populations of the oyster mussel may be attributed to habitat modification, sedimentation, eutrophication, and other forms of water quality degradation. Restricted movement of host fish may also be a factor in the decline of this species. For populations of the oyster mussel on or near the Forest potential management influences include: sedimentation, altered flow, and blockage of host fish passage associated with roads and crossings. Forest-wide and riparian standards will protect the oyster mussel and its habitat from sediment released during management activities and mineral development. Instream flow needs will be quantified and maintained to protect aquatic organisms when new water use authorizations are proposed.

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PINK MUCKET PEARLYMUSSEL (*LAMPSILIS ABRUPTA*)

The pink mucket pearlymussel was federally listed as endangered in 1976. Historically, this species occurred in the Mississippi, Ohio, Cumberland, and Tennessee Rivers. In the Tennessee River it occurred up to the lower Clinch River where it is very rare (Parmalee and Bogan 1998). Although several valves were found at Pendleton Island, Virginia in the Clinch River in the 1980's (Neves, R. 2002), this species is considered extirpated from the state (NatureServe 2002). Historical habitat near the Forest includes the Clinch River where it is thought to be extinct.

This species is typically found in medium to large rivers on substrates ranging from silt and sand to gravel, rubble, and boulders. In the Clinch and Holston Rivers, however, it has been collected from areas of less than three feet of water on rocky substrates. Fish hosts are freshwater drum and sauger.

Table 3-85. Overview of pink mucket pearlymussel occurrences and habitat on and near the JNF

River Basin	Watersheds	Miles On	Miles Near	Counties of Occurrence	Role[1]
Tennessee	Clinch (Thought to be extinct in Virginia)	N/A	N/A		Protect and Manage

[1] Protect = provide suitable water quality since they are downstream; Manage = Manage riparian habitat and protect water quality on the Forest.

Direct, Indirect, and Cumulative Effects

Threats to the pink mucket pearlymussel include modification of habitat (e.g., dams and dredging), degradation of water quality, the zebra mussel and over harvest by commercial mussel industry. (NatureServe 2002).

The decline and extirpation of most populations of the pink mucket pearlymussel may be attributed to habitat modification, sedimentation, eutrophication, and other forms of water quality degradation. Restricted movement of host fish may also be a factor in the decline of this species. For historic habitat of the pink mucket pearlymussel downstream from the Forest potential management influences include: sedimentation, altered flow, and blockage of host fish passage associated with roads and crossings. Forest-wide and riparian standards will protect the pink mucket pearlymussel and its habitat from sediment released during management activities and mineral development. Instream flow needs will be quantified and maintained to protect aquatic organisms when new water use authorizations are proposed. Prior to the stocking of any non-native species, the national forest coordinates with the appropriate State agencies to ensure populations and habitats of native species are maintained.

PURPLE BEAN (*VILLOSA PERPURPUREA*)

The purple bean was federally listed as endangered in 1997. Distribution information used in this analysis is from NatureServe (2002):

Historically distributed throughout the upper Tennessee River system above the confluence with the Clinch River. Presently occurs in portions of the Clinch River, Indian

Creek, Copper Creek, and Beech Creek in northeastern Tennessee and southwestern Virginia. It has been extirpated from the Powell, North Fork Holston, Emory rivers and a portion of the upper Clinch River (USDI Fish and Wildlife Service 1998b).

This species occurs about five miles downstream from the Forest in the Clinch River.

The purple bean is typically encountered in substrate of coarse sand and gravel that include some silt, in moderate to strong current, and at depths of less than three feet. It also occurs in rock piles and under large, flat rocks. Fish hosts are sculpin species, greenside darter, and the fantail darter (Parmalee and Bogan 1998).

Table 3-86. Overview of Purple bean occurrences and habitat on and near the JNF

River Basin	Watersheds	Miles		Counties of Occurrence	Role[1]
		On	Near		
Tennessee	Clinch, Copper Creek	0	5	Tazewell, Russell, Wise, Scott	Protect and Manage

[1] Protect = provide suitable water quality since they are downstream; Manage= Manage riparian habitat and protect water quality on the Forest.

Direct, Indirect, and Cumulative Effects

Threats to the purple bean include chemical and organic pollution, urban development, coal mine effluent, siltation from agriculture and clear-cutting, and damming continue to impact this species (NatureServe 2002).

The decline and extirpation of most populations of the purple bean may be attributed to habitat modification, coal mining, chemical pollution, sedimentation, eutrophication, and other forms of water quality degradation. Restricted movement of host fish may also be a factor in the decline of this species. For populations of the purple bean on or near the Forest potential management influences include: sedimentation, altered flow, and blockage of host fish passage associated with roads and crossings. Forest-wide and riparian standards will protect the purple bean and its habitat from sediment released during management activities and mineral development. Instream flow needs will be quantified and maintained to protect aquatic organisms when new water use authorizations are proposed.

ROUGH PIGTOE PEARLYMUSSEL (*PLEUROBEMA PLENUM*)

The rough pigtoe pearlymussel was federally listed as endangered in 1976 (USDI Fish and Wildlife Service 1984d). It has a state rank of SX indicating that it is presumed extirpated from Virginia. Distribution information used in this analysis is from NatureServe (2003):

Historically widely distributed in the Ohio, Cumberland, and Tennessee River drainages. Currently present in an undetermined number of miles below three Tennessee River mainstem dams (Pickwick, Wilson, and Guntersville) and the upper Clinch River between river miles 323 and 154. Although reported by Parmalee et al. (1980) from the middle Cumberland River between 1977 and 1979, it was not found in recent surveys by Tennessee Valley Authority (1976) or Sickel and Chandler (1996). Present on the Green River, Kentucky between locks 4 and 5 and in the Barren River below Lock and Dam 1 (Ahlstedt, 1984). Historical populations are gone in the upper Ohio River drainage and western parts of its range (Arkansas, Missouri, and Kansas) if in fact it ever occurred there.

This species is typically found in medium to large rivers in sand or gravel substrates (USDI Fish and Wildlife Service 1984d). Parmalee and Bogan (1998) state that "Although Pleurobema plenum may become established in small rivers or in headwater stretches of medium-sized rivers, such as the upper Clinch River, it is a species most typical of large rivers such as the Cumberland."

Host fish species are not known, but may include bluegill and rosefin shiner (Neves 1991)

Direct, Indirect, and Cumulative Effects

Threats to the rough pigtoe pearlymussel include impoundments, siltation, and pollution (USDI Fish and Wildlife Service 1984d).

The decline and extirpation of most populations of the rough pigtoe pearlymussel may be attributed to habitat modification, sedimentation, eutrophication, and other forms of water quality degradation. Restricted movement of host fish may also be a factor in the decline of this species. For historic habitat of the rough pigtoe pearlymussel downstream from the Forest potential management influences include: sedimentation, altered flow, and blockage of host fish passage associated with roads and crossings. Forest-wide and riparian standards will protect the rough pigtoe pearlymussel and its habitat from sediment released during management activities. Instream flow needs will be quantified and maintained to protect aquatic organisms when new water use authorizations are proposed.

ROUGH RABBITSFOOT (***QUADRULA CYLINDRICA STRIGILLATA***)

The rough rabbitsfoot was federally listed as endangered in 1997. Distribution information used in this analysis is from NatureServe (2002):

This species historically was restricted to the Clinch, Powell, and Holston drainage systems, including Indian Creek and Copper Creek. In 1997 the USDI Fish and Wildlife Service reported rough rabbitsfoot in all three drainages but in limited areas with low populations. In 1998, the USDI Fish and Wildlife Service reported it had been extirpated from the entire Holston River system.

This species occurs within 1 mile of the Forest in the Clinch River and within 5 miles in the Powell River.

The rough rabbitsfoot occurs in small to medium sized streams, such as the upper Clinch and Powell, in clear, shallow water on gravel and sand substrates. Shoals and riffles near streambanks seem to be preferred (Parmalee and Bogan 1998). Fish hosts are the bigeye

Table 3-87. Overview of rough rabbitsfoot occurrences and habitat on and near the National Forest

River Basin	Watersheds	Miles		Counties of Occurrence	Role[1]
		On	Near		
Tennessee	Clinch, Powell, N. Fork Holston, Copper Creek	0	1	Scott, Tazewell, Lee, Washington	Protect and Manage

[1] Protect = provide suitable water quality since they are downstream; Manage= Manage riparian habitat and protect water quality on the Forest.

chub, spotfin shiner, and the whitetail shiner.

Direct, Indirect, and Cumulative Effects

Threats to the rough rabbitsfoot include impoundments, channelization, siltation, and pollution (USDI Fish and Wildlife Service 1998b). NatureServe (2002) states:

"Low population levels and few EOs [element occurrences] make this species extremely vulnerable. Impacted by chemical and organic pollution, toxic mine run-off, channel alteration and inundation, siltation from agriculture and clear-cutting, and possibly by collecting (non-commercial). The populations in the lower Clinch, Powell, and Holston river systems were extirpated by reservoirs (USDI Fish and Wildlife Service 1997)."

The decline and extirpation of most populations of the rough rabbitsfoot may be attributed to habitat modification, sedimentation, eutrophication, and other forms of water quality degradation. Restricted movement of host fish may also be a factor in the decline of this species. For populations of the rough rabbitsfoot on or near the Forest potential management influences include: sedimentation, altered flow, and blockage of host fish passage associated with roads and crossings. Forest-wide and riparian standards will protect the rough rabbitsfoot and its habitat from sediment released during management activities and mineral development. Instream flow needs will be quantified and maintained to protect aquatic organisms when new water use authorizations are proposed.

SHINY PIGTOE (***FUSCONAIA COR***)

The shiny pigtoe was federally listed as endangered in 1976. Distribution information used in this analysis is from NatureServe (2002):

Historically occurred throughout the Tennessee River drainage as far south as Muscle Shoals. Its current distribution is scattered over five rivers: the North Fork of the Holston in Virginia, the Clinch (from the Virginia-Tennessee border upstream to Nash Ford), Copper Creek, the Powell (from the Virginia-Tennessee border upstream to Lee County, Tennessee), it has not been seen in the Elk River in Tennessee since 1980 and it is uncommon in the Paint Rock River in Alabama.

Habitat for this species occurs within one mile from the Forest in the Clinch River, and greater than 15 miles from the Forest in the North Fork Holston River.

The shiny pigtoe is typically found in shoal and gravel substrates of clear streams with moderate to fast currents. (Parmalee and Bogan 1998). Known fish host is the whitetail shiner. Possible fish hosts are the common shiner, telescope shiner, and warpaint shiner.

Table 3-88. Overview of shiny pigtoe occurrences and habitat on and near the National Forest

River Basin	Watersheds	Miles On	Miles Near	Counties of Occurrence	Role[1]
Tennessee	N. Fork Holston, Clinch, Powell, Copper Creek	0	1	Smyth, Russell, Lee, Scott	Protect and Manage

[1] Protect = provide suitable water quality since they are downstream; Manage= Manage riparian habitat and protect water quality on the Forest.

Direct, Indirect, and Cumulative Effects

NatureServe cites the following threats: "Threatened by habitat alteration and pollution from strip mine runoff and coal washing. Populations in the North Fork of Holston and Clinch rivers were reduced by toxic discharges and spills prior to 1972. Some sizable populations in the Elk River were destroyed by impoundment of Tims Ford Reservoir. The invasion of the Asian clam, and the possible invasion of the zebra mussel, also threatens remaining populations."

The decline and extirpation of most populations of the shiny pigtoe may be attributed to habitat modification, sedimentation, eutrophication, and other forms of water quality degradation. Restricted movement of host fish may also be a factor in the decline of this species. For populations of the shiny pigtoe on or near the Forest potential management influences include: sedimentation, altered flow, and blockage of host fish passage associated with roads and crossings. Forest-wide and riparian standards will protect the shiny pigtoe and its habitat from sediment released during management activities and mineral development. Instream flow needs will be quantified and maintained to protect aquatic organisms when new water use authorizations are proposed. Prior to the stocking of any non-native species, the national forest coordinates with the appropriate State agencies to ensure populations and habitats of native species are maintained.

CRITICAL HABITAT

Critical habitat has been defined by the USDI. Fish and Wildlife service as:

A specific geographic area(s) that is essential for the conservation of a threatened or endangered species and that may require special management and protection. Critical habitat may include an area that is not currently occupied by the species but that will be needed for its recovery (USDI Fish and Wildlife Service 1998a).

Designated Critical Habitat

On the Forest, designated Critical Habitat exists for two species:

YELLOWFIN MADTOM

Virginia. Lee, Scott, and Russell Counties. Powell River, main channel from the Virginia-Tennessee State line upstream through Lee County. Copper Creek, main channel from its junction with the Clinch River, upstream through Scott County and upstream in Russell County to Dickensonville (USDI Fish and Wildlife Service 1977).

The critical habitat in the Powell River is less than a mile downstream from the Forest.

SLENDER CHUB

Virginia. Lee and Scott Counties. Powell River, main channel from the Tennessee-Virginia State line upstream through Lee County, Va. Clinch River, main channel from the Tennessee-Virginia State line upstream through Scott County, Virginia (USDI Fish and Wildlife Service 1977).

The critical habitat in the Powell River is less than a mile downstream from the Forest. The Forest owns approximately ¼ mile of one bank of the Clinch River within the designated critical habitat.

Proposed Critical Habitat

On the Forest, proposed Critical Habitat exists for four species (Cumberlandian combshell, rough rabbitsfoot, oyster mussel, purple bean) (USDI Fish and Wildlife Service 2003):

UNIT 4. POWELL RIVER, CLAIBORNE AND HANCOCK COUNTIES, TENNESSEE, AND LEE COUNTY, VIRGINIA

Unit 4 encompasses 154 rkm (94 rmi) and includes the Powell River from the U.S. 25E Bridge in Claiborne County, Tennessee, upstream to river mile 159 (upstream of Rock Island in the vicinity of Pughs) Lee County, Virginia. This reach is currently occupied by the Cumberlandian combshell (Ahlstedt 1991; Gordon 1991), rough rabbitsfoot (Service 2003), and oyster mussel (Wolcott and Neves 1990), and was historically occupied by the purple bean (Ortmann 1918). It is also existing critical habitat for the Federally listed slender chub (Erimystax cahni) and yellowfin madtom (Noturus flavipinnis).

This proposed critical habitat in the Powell River is about five miles downstream from the Forest.

UNIT 5. CLINCH RIVER AND TRIBUTARIES, HANCOCK COUNTY, TENNESSEE, AND SCOTT, RUSSELL, AND TAZEWELL COUNTIES, VIRGINIA

Unit 5 totals 272 rkm (171 rmi), including 242 rkm (148 rmi) of the Clinch River from rkm 255 (rmi 159) immediately below Grissom Island, Hancock County, Tennessee, upstream to its confluence with Indian Creek in Cedar Bluff, Tazewell County, Virginia; 4 rkm (2.5 rmi) of Indian Creek from its confluence with the Clinch River upstream to the fourth Norfolk Southern Railroad crossing at Van Dyke, Tazewell County, Virginia; and 21 rkm (13 rmi) of Copper Creek from its confluence with the Clinch River upstream to Virginia State Route 72, Scott County, Virginia. The Clinch mainstem currently contains the oyster mussel, rough rabbitsfoot, Cumberlandian combshell, and purple bean (Gordon 1991; Ahlstedt and Tuberville 1997; S.A. Ahlstedt, USGS, pers. comm. 2002). Indian Creek currently supports populations of the purple bean and rough rabbitsfoot (Winston and Neves 1997; Watson and Neves 1998). Copper Creek is currently occupied by a low density population of the purple bean, and contains historic records of both the oyster mussel and rough rabbitsfoot (Ahlstedt 1981; Fraley and Ahlstedt 2001; Ahlstedt, pers. comm. 2003). Copper Creek is critical habitat for the yellowfin madtom and a portion of the proposed Clinch River mainstem section is critical habitat for both the slender chub and the yellowfin madtom.

The Forest owns approximately ¼ mile of one bank of the Clinch River within the proposed critical habitat.

Under all alternatives, implementation would result in no destruction or adverse modification to designated or proposed critical habitat because Forest-wide and riparian management direction is designed to not only minimize adverse impacts to aquatic and riparian areas, but to maintain them as healthy, functioning systems.

REGIONAL FORESTER'S SENSITIVE SPECIES

The objective of sensitive species designation is to ensure that Forest Service actions do not contribute to loss of viability of any native or desired non-native species or contribute to trends toward federal listing, and to provide a process and standard to ensure that these species receive full consideration in the decision-making process.

BIOLOGICAL ENVIRONMENT

THREATENED, ENDANGERED, SENSITIVE AND LOCALLY RARE SPECIES

REGIONAL FORESTER'S SENSITIVE SPECIES

The current list of Regional Forester's sensitive species took effect on August 7, 2001 and may be updated when new information indicates changes in species' status. The list will be updated by the Regional Office and does not require a Plan Amendment to become official.

Sensitive species will be managed using a two-tiered approach. Under all alternatives, except F (the 1985 Forest Plan), rare natural communities and habitats will be protected under the Rare Communities management prescriptions (9F) and under the Special Biological Area management prescription (4D). This protection will serve as a "coarse filter," capturing many sensitive species. Since all sensitive species will not be covered by the coarse filter, a "fine" filter will be used to protect them. The fine filter is the project review process that includes field surveys conducted before on-the-ground activities take place. Alternative F does not identify or protect rare communities unless a federally listed species is found within. Under Alternative F, sensitive species are protected according to Forest Service policy.

Direct and Indirect Effects

All alternatives include the general goal of contributing towards the recovery of federally-listed threatened and endangered species. Additionally, the following activities are common across all alternatives:

- Recovery plans (when available) will be followed for all threatened and endangered species;
- Forest-wide population objectives for threatened, endangered, and candidate plants will be followed;
- Forest-wide standards will be followed. For example, "sites supporting federally-listed threatened and endangered species or individuals needed to maintain viability are protected from detrimental effects caused by management actions";
- Threatened, endangered, and sensitive species will be conserved through the site-specific biological evaluation process;
- Surveys for all TES and their habitats will continue to be conducted on the Forest, particularly as part of the biological evaluation process in conjunction with projects likely to affect habitat for the species (project-level surveys would be conducted in accordance with procedures outlined in the Region 8 supplement of Forest Service Manual 2672);
- Monitoring of known populations of threatened, endangered, and sensitive species will be conducted consistent with Forest Manual direction.

Direct effects to threatened, endangered, or sensitive species could occur in the event new populations are overlooked during project-specific surveys, especially to TES occurring in upland, disturbance-dependent habitats, but direct effects are expected to be small and not likely to jeopardize the continued existence of the species. Project-level surveys would be conducted in accordance with procedures outlined in the Region 8 supplement of Forest Service Manual 2672.

Several management prescriptions facilitate the conservation of habitat for threatened, endangered, and sensitive species habitat across all alternatives with the exception of Alternative F, current management. The Riparian management prescription (11), with its emphasis on low levels of disturbance, and maintenance of aquatic and riparian values, conserves habitat for the aquatic TES such as mussels, fish, and aquatic insects. The Rare Communities management prescription (9F) and associated goals and forest-wide or prescription-level standards, will provide optimal habitat conditions for the majority of TES species. This prescription will also be applied across all alternatives with the exception of

Alternative F.

Several TES species, including Virginia spiraea and Virginia round-leaf birch, require active management to reduce competition by invasive plant species. Some species, such as piratebush and sword-leaved phlox require fire to maintain their habitat. All alternatives use appropriate management tools to protect and maintain TES species whether that entails passive or active management.

As a result of implementing all alternatives, there are likely to be indirect, beneficial effects to habitats for all TES, though the magnitude of the habitat benefits will vary somewhat across alternatives. Benefits are likely to be greatest under Alternatives B (which emphasizes biological restoration) and G (which emphasizes TES habitat and watershed restoration), followed by Alternative I (the proposed action). Benefits to TES would be less under Alternatives A, D, and E, and least under Alternative F (current management).

PEAKS OF OTTER SALAMANDER MANAGEMENT INDICATOR SPECIES

The Peaks of Otter salamander (*Plethodon hubrichti*) is a Management Indicator Species because it is a Sensitive species and a narrow endemic that occurs almost entirely on the Jefferson National Forest and the Blue Ridge Parkway. This species requires mature, moist hardwood forest. While a significant portion of the range is dedicated to non-management uses, timber harvest is allowed in about 60% of the range. Population comparisons between managed and non-managed areas can indicate the effects of timber management on this species.

Under all alternatives the Peaks of Otter salamander will be protected under Plan Standards derived from a Conservation Agreement (Table 3-89). Timber management is allowed in part of the salamander's range, but with restrictions to maintain its habitat. Under all alternatives the population trend for the Peaks of Otter salamander is expected to remain stable.

Table 3-89. Expected population trend[1] of the Peaks of Otter Salamander on the Jefferson National Forest under Forest Plan Revision alternatives 10 and 50 years following plan adoption. Population trend estimates are based on expected trends in habitat quality and quantity.

Time Period	Alternative						
	A	B	D	E	F	G	I
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.

Cumulative Effects to TES Species

The Jefferson National Forest has an ownership pattern that is highly fragmented by private land. Based on a broad scale watershed assessment for the Forest, only seven 5th order watersheds of the 36 5th order watersheds identified, contain over 25% of their area in National Forest. This fragmented ownership patterns can limit landscape level efforts required for some TES species, especially wide-ranging species, those associated with aquatic habitats, or those requiring landscape-level restoration processes such as the

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use of prescribed fire.

Public land plays a critical role in the conservation of federally listed plants, all TES habitats, and sensitive species, all of which may receive no protection on private land.

During the next 10 to 50 years of forest plan implementation, human populations are likely to expand affecting urbanization, roads and associated traffic, and the use of the National Forests by humans. This suggests the public land will play an increasingly important role in the conservation of threatened, endangered, and sensitive species in the future, but that management to ensure recovery and/or prevent federal listing of species will be an increasingly difficult challenge.

All Forest Plan alternatives contain goals and forest-wide standards, and are subject to laws, regulations, and Forest Service policy requiring the conservation of threatened, endangered, and sensitive species. This suggests that the cumulative effects of implementing all alternatives will be beneficial.

TERRESTRIAL VIABILITY EVALUATION

National Forest Management Act (NFMA) 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.

The Southern Appalachian region supports extremely high levels of biological diversity relative to other regions, viewed both nationally and globally. As a result, large numbers of species are present for which population viability may be of concern. Detailed demographic or habitat capability analysis to evaluate population viability is not feasible for this large number of species. Therefore, our goals for this evaluation are to use a clearly defined, transparent process to identify species for which there are substantive risks to maintenance of viable populations, and to ensure consideration of appropriate habitat management strategies to reduce those risks to acceptable levels where feasible.

For comprehensiveness and consistency, evaluation of species viability was coordinated across several national forests undergoing simultaneous plan revisions. These forests are the Jefferson National Forest, Cherokee National Forest, Sumter National Forest, Chattahoochee and Oconee National Forests, and National Forests in Alabama. These forests encompass portions of the Southern Appalachian, Piedmont, and East Gulf Coastal Plain ecoregions. However, the scale for this assessment is set by NFMA regulations as the "planning area," or the area of the National Forest System covered by a single forest plan. Therefore, a separate risk assessment was done for each national forest covered by a separate forest plan. Although viability evaluation was coordinated across the ecoregions, analysis presented here focuses on information relevant to the Jefferson National Forest.

Because NFMA regulations require providing habitat for species viability within the planning area, focus of this evaluation is on habitat provided on national forest land. Surrounding private lands may contribute to, or hinder, maintenance of species viability on national forest land, but are not relied upon to meet regulation requirements. For this reason, habitat abundance was assessed based on conditions found on national forest land. Habitat distribution, however, was assessed considering the condition of intermixed ownerships and conditions, which may affect the interactions of species among suitable habitat patches on national forest land.

Evaluation of migratory birds focused on breeding populations only, unless otherwise indicated. This focus does not mean that wintering and migrating populations were not considered during planning, but that viability evaluation makes most sense when viewed in terms of the relative stability of breeding populations.

NatureServe, under a Participating Agreement with the Forest Service, compiled much of the foundational information used in this evaluation. NatureServe is an international non-profit organization, formerly part of The Nature Conservancy. Its mission is to develop, manage, and distribute authoritative information critical to conservation of the world's biological diversity. Partnership with NatureServe was sought as a means to ensure the best available information on species status and habitat relationships was used in this evaluation. Under this agreement, NatureServe staff engaged numerous species experts and state heritage programs to develop a relational database that includes relevant information on species' status, habitat relationships, and threats to viability.

VIABILITY EVALUATION PROCESS

Risk to maintenance of viability over the next 50 years was assessed for each species in relation to each of its principle habitat relationships by plan revision alternative. Risk assessment was based on three factors: 1) current species abundance; 2) expected habitat abundance in 50 years; and 3) expected habitat distribution in 50 years (Figure 3-5). Once risk ratings were developed, we assessed how well management strategies across alternatives provide for species viability.

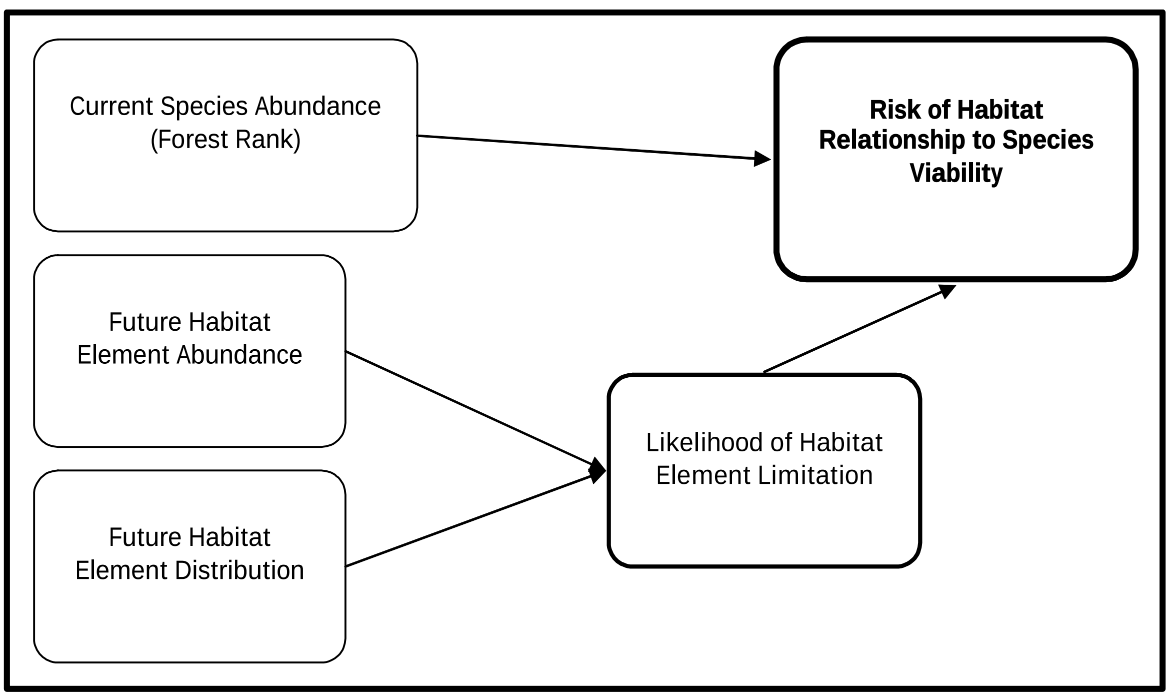

Figure 3-5. Relationship of variables used to rate the risk to viability resulting from a species' relationship with a habitat element.

BIOLOGICAL ENVIRONMENT

THREATENED, ENDANGERED, SENSITIVE AND LOCALLY RARE SPECIES

TERRESTRIAL VIIABILITY EVALUATION

VIABILITY EVALUATION PROCESS

A comprehensive list of species with potential viability concern was compiled for the Jefferson National Forest. The list includes those species found, or potentially found, on the National Forest from the following categories:

- Species listed as proposed, threatened, or endangered under the federal Endangered Species Act;
- Species listed on the Regional Forester's Sensitive Species list;
- Species identified as locally rare on the National Forest by Forest Service biologists;
- Birds of conservation concern as identified by the US Fish and Wildlife Service; and
- Declining species of high public interest.

Species lists from all national forests in the Southern Appalachian and Piedmont Eco-regions, and Coastal Plain forests in Alabama, were pooled to create comprehensive lists of species of potential viability concern. NatureServe staff and contractors assigned abundance ranks for each species on the comprehensive eco-region list for the Jefferson National Forest. These Forest Ranks, or F Ranks, follow the conventions used by NatureServe and others in defining State and Global Ranks (Table 3-90).

Table 3-90. Forest Ranks (F Ranks) and definitions used to define status of species on the JNF as part of species viability evaluation for forest plan revision as of 2002

F Rank	F Rank Definition
F0	Not present; no known occurrences on the forest unit, and forest is outside species' range or habitat is not present.
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.
F?	Present on the forest, but abundance information is insufficient to develop rank.
FP	Possibly could occur on the forest unit, but documented occurrences not known.
FH	Of documented historical occurrence on the forest unit; may be rediscovered.
FX	Once occurred but has been extirpated from the forest unit; not likely to be rediscovered.

F Ranks were used in viability risk assessment as a categorical variable representing a species' current abundance. Forest Service biologists reviewed F Ranks developed by NatureServe to identify any inconsistencies between these rankings and Forest Service information. Discrepancies in this abundance variable were resolved through coordination with NatureServe and its contractors. Where conflicting information or opinion on species abundance occured, the most conservative information (i.e., that indicating lowest abundance) was used.

Only those species that are both confirmed present and rare or of unknown abundance (F1 through F3, and F?) on the Jefferson National Forest were assessed for viability risk.

Species ranked as F? were treated as F1 species to provide a conservative approach to those species for which abundance information is not available. Species that are currently abundant on the forest (F4, F5) are assumed to be at low risk of losing viability within the next 50 years and therefore, were not further evaluated for viability risk.

Because viability regulations focus on the role of habitat management in providing for species viability, habitat condition was the primary factor used to drive species viability evaluation. NatureServe staff and contractors identified habitat relationships for all species of potential viability concern, linking each species to vegetation community types, successional stages, and habitat attributes as appropriate. Based on this information, each species was linked by Forest Service biologists to one or more habitat elements. These habitat elements (Table 3-91) roughly correspond to categories of management direction included in the Plan and to sections of effects analysis included in this environmental impact statement. NatureServe staff reviewed and provided adjustments to species' assignment to these habitat element groups.

Effects to these habitat elements are analyzed in this EIS under other sections. Based on these analyses, each habitat element was assigned categorical values by alternative to indicate future abundance (Table 3-92) and distribution (Table 3-93), general likelihood that the habitat element would limit viability of associated species (Table 3-94), and overall effect of national forest management on the habitat element (Table 3-95).

The future abundance variable (Table 3-92) is defined as the abundance of the associated habitat element in fifty years if the alternative were selected and implemented over that fifty-year period. This variable indicates the abundance of the habitat element on national forest land only, to provide focus on the role of the national forest planning area in supporting associated species. Its focus on national forest land only reflects recognition that viability is to be provided within the 'planning area' (area covered by the Forest Plan). Definitions of abundance categories are stated in quantifiable terms in order to be objective as possible; however, in many cases quantifiable estimates of future abundance are not available. In these cases, knowledge of Forest Service biologists was used to assign abundance values based on current conditions and the magnitude and direction of effects expected under each alternative.

Similar to the future abundance variable, the future distribution variable (Table 3-93) is defined as the distribution of the associated habitat element in fifty years if the alternative were selected and implemented over that fifty-year period. In contrast to the abundance variable, it includes consideration of intermixed ownership patterns and conditions, and their general effects on movements and interactions of individuals among the suitable habitat patches found on national forest land. Because assessing adequacy of habitat distribution for a species requires a level of knowledge not available for most species, and the number of species being evaluated is very large, we have defined habitat distribution in terms of a historical reference condition—that which was present prior to the major perturbations associated with European settlement of the planning area. This period is generally defined as 1000 to 1700 A.D. This approach relies on the assumption that a habitat distribution similar to that which supported associated species during recent evolutionary history will likely contribute to their maintenance in the future, and that the further a habitat departs from that historical distribution, the greater the risk to viability of associated species. This approach has its own set of difficulties, as evidence of presettlement conditions relevant to the planning area is often anecdotal and scarce. In addition, the reference period may have included a wide variety of conditions as a result of growing aboriginal populations and accompanying use of agriculture and fire during the early portion of this period, and their subsequent dramatic decline due to disease

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Table 3-91. Habitat elements used to plan for, and assess risk to, viability of terrestrial species during Jefferson National Forest Plan Revision.

Habitat Element	Element Description
Bogs, Fens, Seeps, Seasonal Ponds	Bogs, fens, seeps, seasonal ponds characterized by saturated soils
Open Wetlands	Open wetlands, marshes, beaver ponds, generally characterized by having some permanent standing water
River Channels	Riverine gravel and sand bars, and river banks subject to flood scour
Glades and Barrens	Glades and barrens characterized by shallow soils, exposed parent material, and sparse or stunted vegetation
Carolina Hemlock Forests	Forests dominated by Carolina hemlock
Table Mountain Pine Forests	Forests and woodlands dominated by table mountain pine and maintained by periodic fire
Spruce-Fir Forests	High elevation forests dominated by healthy red spruce and Fraser fir
Beech Gap Forests	Forests at high elevation mountain gaps dominated by American beech and subject to wind and frost effects.
Basic Mesic Forests	Basic mesic or "rich cove" forests characterized by calciphilic herbs and usually dominated by maples, basswood, and buckeye.
Rock Outcrops and Cliffs	Rock outcrops and cliffs characterized by exposed rock, shallow soils and sparse vegetation
Grassy Balds	Grassy balds
Shrub Balds	Shrub balds
Canebrakes	Canebrakes characterized by dense stands of cane and open canopies, usually within riparian areas
Caves and Mines	Caves and mines with microclimates capable of supporting associated biota
Mature Mesic Hardwood Forests	Mid- and late-successional mesic deciduous forests, including northern hardwood, mixed mesophytic, mesic oak, and bottomland hardwood forests
Mature High-Elevation Mesic Hardwood Forests	Mid- and late-successional mesic hardwood forests at high elevations, primarily northern hardwood forests
Mature Hemlock Forests	Mid- and late-successional eastern hemlock and eastern hemlock-white pine forests in native settings, typically on stream terraces and other mesic sites
Mature Oak Forests	Dry to mesic mid- and late-successional oak and oak-pine forests subject to moderate levels of disturbance sufficient to maintain the oak component
Mature Yellow Pine Forests	Mid- and late-successional southern yellow pine and pine-oak forests maintained in open conditions by frequent fire
Early-Successional Forests	Early-successional forests, typically aged 0-10 years and dominated by woody species
High Elevation Early Succession	Early-successional habitats at high elevations, including early-successional forests, open woodlands, and old fields
Mature Forest Interiors	Mature forest interiors with minimal adverse effects due to forest edge.
Canopy Gaps	Mid- and late-successional mesic deciduous forests with a diverse vertical and horizontal structure as a result of gaps in the canopy
Woodlands, Savannas, and Grasslands	Open woodlands and savannas characterized by low canopy cover and rich grass-dominated understories, and maintained in open conditions by periodic fire. Grasslands with little to no overstory, usually occurring as patches within woodland and savanna complexes and maintained by periodic fire.
Mixed Landscapes	Landscapes characterized by a broad mix of successional habitats
Late Successional Riparian	Riparian areas dominated by mid- and late-successional deciduous forests
Early-Successional Riparian	Riparian areas with a dense understory or early-successional forest in riparian areas
Snags	Forests containing an abundance of snags
Downed Wood	Forests containing an abundance of downed wood and thick leaf litter
Den Trees	Forests containing an abundance of large hollow trees suitable as den trees
Hard Mast	Forests producing abundant hard mast
Remoteness	Remote habitats away from frequent human disturbance
Lakeshores	Forested shores of lakes and ponds
Water Quality	High water quality in streams and lakes

Table 3-92. Habitat abundance values used to categorize projected abundance of each habitat element after 50 years of implementing each forest plan revision alternative

Habitat Abundance Value	Description
Rare	The habitat element is rare, with generally less than 100 occurrences, or patches of the element generally covering less than 1 percent of the national forest planning area.
Occasional	The habitat element is encountered occasionally, and generally is found on 1 to 10 percent of the national forest planning area.
Common	The habitat element is abundant and frequently encountered, and generally is found on more than 10 percent of the national forest planning area.

Table 3-93. Habitat distribution values used to categorize projected distribution of each habitat element after 50 years of implementing each forest plan revision alternative

Habitat Distribution Value	Description
Poor	The habitat element is poorly distributed within the planning area and intermixed lands relative to conditions present prior to European settlement. Number and size of habitat patches and/or their evenness in distribution across the landscape are greatly reduced.
Fair	The habitat element is fairly well distributed within the planning area and intermixed lands relative to conditions present prior to European settlement. Number and size of habitat patches and/or their evenness across the landscape are somewhat reduced.
Good	The habitat element is well distributed within the planning area and intermixed lands relative to conditions present prior to European settlement. Number and size of habitat patches and/or their evenness across the landscape are similar to or only slightly reduced relative to reference conditions.

Table 3-94. Likelihood of habitat limitation (High, Moderate, and Low) to associated species as derived from habitat abundance and distribution values

Habitat Abundance	Habitat Distribution		
	Poor	Fair	Good
Rare	High	High	Moderate
Occasional	High	Moderate	Low
Common	Moderate	Low	Low

Table 3-95. Viability risk ratings for species/habitat interactions as a function of a species' F Rank and likelihood of habitat element limitation

Likelihood of Habitat Element Limitation	Species F Rank			
	F1 or F?	F2	F3	F4, F5
High	Very High	High	Moderately High	Moderate
Moderate	High	Moderately High	Moderate	Low
Low	Moderately High	Moderate	Low	Low

epidemics following early European contact. Nevertheless, the precision required to assign the categorical values for this variable is not high, and may be supported by general positions described in mainstream conservation literature (see Wear and Greis 2002). Knowledge of Forest Service biologists was used to assign distribution values, based on interpretations of historical conditions supported by conservation literature, current conditions, and magnitude and direction of effects expected under each alternative.

Differences in scale between the Habitat Abundance and Habitat Distribution variables are intentional in order to bring two different pieces of information into the analysis. Habitat Abundance has been defined in terms of the amount of habitat on national forest land only. This definition reflects the amount of habitat available to support a species on the national forest, in recognition of regulation requirements that viability be provided within the 'planning area.' Habitat Distribution, on the other hand, is defined to include the landscape setting of national forest lands, which includes the intermingled private lands and broken ownership patterns that provide the context for national forest populations and may affect the ability of individuals living on national forest lands to interact with each other.

Habitat element abundance and distribution variables were combined to create one variable to indicate the general likelihood that the habitat element would be limiting to populations of associated species (Table 3-94). In this general context, habitat limitation

Table 3-96. Values used to categorize the role of national forest management in minimizing or contributing to species viability risk associated with each habitat element by forest plan revision alternative.

Management Role Value	Description
1	Abundance and distribution of the habitat element is maintained or improved by providing optimal protection, maintenance, and restoration to all occurrences (with limited exceptions in some cases). Little additional opportunity exists to decrease risk to viability of associated species
2	Abundance and distribution of the habitat element is improved through purposeful restoration, either through active management or passively by providing for successional progression. Opportunity for decreasing risk to associated species is primarily through increasing rates of restoration,
3	The habitat element is maintained at approximately current distribution and abundance, though location of elements may shift over time as a result of management action or inaction. Opportunity to reduce risk to viability of associated species is primarily through adopting and implementing
4	Regardless of management efforts, the habitat element is expected to decrease in distribution and abundance as a result of factors substantially outside of Forest Service control (e.g., invasive pests, acid deposition). Opportunity to reduce risk to viability of associated species is primarily
5	The habitat element is expected to decrease in distribution and abundance as a result of management action or inaction. Opportunity to reduce risk to viability of associated species is primarily through adopting and implementing objectives to maintain or increase this habitat element.

refers to a habitat factor (quantity, distribution, or quality) that results in risk to continued existence of the species within the planning area. Everything else being equal, quality habitat elements that are rare and poorly distributed are those most likely to cause risk to viability of associated species; those that are common and well distributed are least likely to cause risk to viability of associated species.

Providing for species viability requires providing abundant and well-distributed habitat in ways that allow existing populations to persist or expand. The ability of existing populations to respond to available habitat depends in part on their current robustness, which is generally a function of population size. In general, for a given habitat condition, small populations will be at more risk than large populations. To reflect this fact, likelihood of habitat limitation variable was combined with a species' F Rank for each species/ habitat element interaction to generate viability risk ratings (Table 3-95). Associations of very rare species with habitat elements that are likely to be most limiting were identified as those most at risk; associations of more common species with habitats less likely to be limiting received lower risk ratings. Ratings include three levels of 'high' risk (Table 3-95) to ensure that results err on the side of caution.

Once viability risk ratings were developed for each species/habitat relationship, habitat elements most commonly associated with risks to species viability were identified by counting the number of very high, high, and moderately-high ratings associated with each. To assess the role of national forest management in minimizing viability risk associated with each habitat element, a management role effects variable was assigned to each habitat element by alternative. The management effects variable (Table 3-96) categorizes the goal of management for the habitat element, the expected resulting trend, and any additional opportunity for minimizing viability risk. Numbers of very high, high, and moderately-high risk ratings were summarized by management effects variable by alternative to assess how well alternatives address viability-related habitat needs.

Distribution of viability risk was also summarized by species status, i.e., federally listed under the Endangered Species Act, listed as Regional Forester's sensitive species, or identified as locally rare or of other concern. The species status summary highlights the relative role of other provisions included in law and policy that result in additional consideration of at-risk species during planning.

VIABILITY EVALUATION RESULTS

Species viability evaluation for the Jefferson National Forest included consideration of over 1,200 species of the Southern Appalachian ecoregion. Of these species, 327 from the Southern Appalachian ecoregion may possibly occur on the Jefferson National Forest.

Outcomes for habitat elements, as described under individual effects analysis sections, are summarized in Table 3-97, using the four variables (abundance, distribution, likelihood of limitation, and management effects) described in Table 3-98, Table 3-99, Table 3-100, and Table 3-96. These variables indicate expected habitat condition following fifty years of implementing each forest plan revision alternative.

Ratings of risk to viability for each species/habitat relationship by alternative are presented in Appendix E, Table E-1. To facilitate comparison of effects of alternatives on species viability, the number of very-high, high, and moderately-high risk ratings are summarized for each alternative by habitat element (Table 3-98), management effect (Table 3-99), and species status (Table 3-100).

(Continued on page 236)

Table 3-97. Summary of outcomes by habitat element under different alternatives.

Bogs, Fens, Seeps, Seasonal Ponds	Bogs, fens, seeps, and seasonal ponds are critical to maintaining species viability due to their natural rarity on the landscape, their decline during European settlement due to beaver control and drainage for agriculture, and the number of rare species associated with them. Provisions of the rare community prescription provide for optimal protection and management of all occurrences of these habitats under all alternatives except Alternative F; therefore, opportunities for further reducing risk to viability of associated species are limited. Under Alternative F such habitats would likely be maintained, but would not receive the focused attention provided by the rare community prescription.
Open Wetlands	Beavers were the primary source of this habitat on the Jefferson. Distribution of beaver ponds has been reduced from historical levels by control activities and trapping. Some limited improvement of distribution may be the result of human impoundments. Beaver activity may increase in the future, but will not likely reach historical levels. Outcomes are the same across alternatives, through passive restoration and protection under the rare community prescription, except for Alternative F, which may not explicitly recognize the community for protection and maintenance, especially when beavers are involved.
River Channels	Channelization and floodplain and flow alteration for pasture, agriculture, and impoundments have reduced distribution of these habitats in quality condition. Private land holdings will continue to limit restoration to historical distribution. Outcomes are the same across alternatives due to focus provided by the riparian and rare community prescription, except for Alternative F, which is a little less proactive and stringent on protecting these habitats.
Glades and Barrens	Sites other than shale barrens need burning for restoration, but once restored within 50 years are probably not much changed on the national forest from historical distribution due to the stability of physical conditions that create these communities. Outcomes are the same across alternatives due to provisions of the rare community prescription, except for Alternative F, which may not explicitly recognize these communities for proactive restoration and maintenance.
Carolina Hemlock Forests	These forests are likely to be reduced in distribution in the future due to hemlock wooly adelgid, for which there is no known effective control. This outcome is likely regardless of the rare community prescription. Outcomes are the same across all alternatives.
Table Mountain Pine Forests	Distribution of these forests should be improved with restoration and maintenance, but prevalence of fire on the Jefferson needed to maintain this community will probably still be less than that which occurred historically. Prescriptions that provide for the use of prescribed fire would result in the same level of restoration and maintenance of existing sites, with Alternatives F and E resulting in the continuing decline of this type due to neglect. Active restoration to expand the type varies across alternatives with Alternative B resulting in better distribution, and Alts G, I, and D providing less.
Spruce-Fir Forests	Spruce-fir forests are critical to maintaining species viability because they are naturally limited to the highest elevations, and represent the edge of range for many associated species. They therefore support large numbers of species of potential viability concern. While their distribution may be somewhat reduced over historical conditions, the biggest threats to this community and associated species are impacts from the balsam wooly adelgid, for which effective control methods are not known. Little opportunity for reducing risks through typical national forest management is apparent under any alternative. However, Alternative G eliminates fire and grazing management of the open areas in the Crest Zone of Mount Rogers, resulting in increased acreage of this community over the 50 year time period.
Beech Gap Forests	This community is limited to high elevation topographic positions that make its distribution relatively rare. These communities are being severely impacted by beech bark disease, regardless of alternative. Outcomes are the same for all alternatives.

Table 3-97. Cont'd. Summary of outcomes by habitat element under different alternatives.

Basic Mesic Forests	Although many of these sites have been logged in the past, with future protection they are restorable to near historic distribution on the national forest. However, these communities are naturally rare on the Jefferson due to the lack of these nutrient rich sites. These communities are also susceptible to non-native invasive plant species, thereby reducing the habitat quality of these areas. Outcomes are the same across alternatives, except for Alternative F, which does not recognize this community for protection. Under Alternative F these areas may be available for timber production and early seral wildlife habitat, reducing their distribution relative to other alternatives.
Rock Outcrops and Cliffs	Distribution of such sites has been and should continue to be relatively stable over time under all alternatives due to the stability of the factors that define them. Outcomes are the same across all alternatives, except Alternative F which does not explicitly recognize these communities for protection.
Spray Cliffs	Distribution of such sites has been and should continue to be relatively stable over time due to the stability of the factors that define them. Riparian and rare community prescriptions protect these under all alternatives, except Alternative F. Outcomes are the same across alternatives, except for the benign neglect of Alternative F.
Grassy Balds	Debate exists concerning the historical distribution of this community, but it is not likely to have been significantly different from today's distribution. Due to this debate, Alternative G eliminates all fire and grazing management activities designed to maintain these communities and Alternative B maintains a reduced acreage of balds. With the exception of Alternatives G and B, this community would be restored and maintained into the future under all alternatives under the rare community prescription or existing management direction in Alternative F. Outcomes are the same under Alternatives A, B, D, E, F, and I.
Shrub Balds	Distribution of shrub balds has been and should continue to be relatively stable over time due to the environmental conditions under which they develop, namely slope position and shallow soils. It is likely that over time these sites could develop into Spruce-fir or northern hardwood forest. There are only 5 known occurrences on the Mount Rogers NRA. Outcomes are the same across alternatives, except for the benign neglect under Alternative G as opposed to focused attention under other alternatives as a result of the rare community prescription, or existing management direction in Alternative F.
Canebrakes	Once extensive due to shifting agriculture of Native Americans and grazing of large ungulates, these communities have almost disappeared. It is unclear how many if any occurred on the Jefferson National Forest. Restoration efforts will be minimal under all alternatives, except Alternative F which included no restoration of this community.
Caves and Mines	Distribution may have increased due to creation of mines, and would be maintained through protection of all sites under all alternatives due to the rare community prescription, riparian prescription, and forestwide standards for bats. Alternative F is assumed to include protection of such sites as a result of current plan direction.
Mature Mesic Hardwood Forests	This habitat was likely widespread historically and will remain so on national forest lands in the future under all alternatives; however, ownership patterns and conversions to other land uses on private lands have somewhat reduced ability of species to interact among patches. Loss of chestnut has impacted the quality of this habitat element. Increases in mature forests are expected under all alternatives, with especially large increases under E and G, and lower increases under Alternative F, but general outcomes--that such habitats will be common and fairly well distributed--are the same across alternatives.

Table 3-97. Cont'd. Summary of outcomes by habitat element under different alternatives.

Mature High-Elevation Mesic Hardwood Forests	This habitat was likely the predominate condition at high elevations (greater than 3500 feet) and currently still is. It will likely remain so in the future under all alternatives. Early-successional habitat creation and maintenance would not be expected to substantially alter distribution of this habitat as it would still be the predominant matrix condition at high elevations. Loss of chestnut has impacted the quality of this habitat element.
Mature Hemlock Forests	Healthy examples of the community are likely to be reduced, and in all likelihood eliminated, in the future under all alternatives by the hemlock wooly adelgid.
Mature Oak Forests	This habitat was likely to have been widespread historically, but often as subcomponent of chestnut forests. Loss of chestnut has impacted the quality of this habitat element. It has replaced chestnut to increase its distribution, but it is threatened by approaching gypsy moth infestation, which may reduce distribution in the future. Alternatives that emphasize active management of these forests ensure adequate oak regeneration sustaining this community into the future. Alternative D would have the greatest potential for maintaining and/or increasing the amount of oak forests with a higher percentage in the less than mature age classes. Alternative G maintains this community primarily through increased prescribed burning. Alternative E would result in some loss of oak forest as it matures, dies, and is replaced by shade-tolerant tree species. In addition, active management in Alternative E emphasizes shade tolerant species.
Mature Yellow Pine Forests	This community was likely a common component of the historical landscape, but has been greatly reduced in quality and distribution by long term by fire exclusion, resulting in increased infestation and mortality by the southern pine beetle. Although restoration rates would vary among alternatives, general outcomes would be the same because even under the most aggressive restoration Alternative B, it is not possible to reintroduce fire as extensively as necessary to restore this habitat element to historical levels. Alternatives F and E would result in
Early-Successional Forests	This habitat element was an occasional seral stage component of the historical landscape mosaic. In the historical landscape, this habitat element was created through windstorms, beaver activity, lightning fire, and Native American agriculture and fire. Its maintenance on the future landscape varies by alternative, with Alts E and G resulting in lower distribution and abundance and Alts D and F providing greater distribution and abundance.
High Elevation Early Succession	Distribution likely increased during settlement, but has declined recently. Maintenance of these habitats should keep them at levels lower than recent history, but higher than present. Somewhere in between likely represents historical reference conditions. Alts E and G would maintain less, and Alternative D would maintain more. Alternative F would maintain present abundance and distribution.
Mature Forest Interiors	This condition was likely widespread historically and is dependent in large part on landscape context. It will likely remain widespread in the future on national forest lands under all alternatives due to the large block of mature forest represented by the national forest. However, private land effects reduce distribution to fair. Alternatives A, D, and F not only create slightly more early successional habitat, but also involve more road construction contributing to a decline in this habitat element.
Canopy Gaps	Characteristic of older forests, this condition was likely widespread historically, and will improve in distribution over time. Although 2/3 of the Jefferson will be 140 years of age in 50 years and insects and disease (notably gypsy moth) will contribute to this habitat element, historic levels of old growth forest conditions (represented by this element) will take more than 50 years to develop. Canopy gap creation is designed to create more stand structure in our predominately 90 year old forest in the short-term. Although level of active canopy gap creation would vary by alternative, these would be small relative to overall abundance and distribution of the condition. Therefore, outcome variables for distribution and abundance are the same across alternatives.

Table 3-97. Cont'd. Summary of outcomes by habitat element under different alternatives.

Woodlands and Savannas	Historically present on xeric sites due to frequent (every 3-5 years) fire, this habitat element is much reduced today. Restoration will improve its distribution, but not likely to historic levels under any alternative. Restoration of this habitat element is emphasized in Alternative B. Alternative E would restore the least amount of this habitat element.
Grasslands	Historically present on xeric sites due to presence of fire, these habitats are much reduced today. Restoration will improve their distribution, but not likely to historical levels under any alternative. Maintenance of the few truly good examples, but no real emphasis on restoration would occur under Alts A, D, and F. Some emphasis on restoration would occur under Alts E, G, and I. Full restoration would occur under Alternative B.
Mixed Landscapes	This habitat element is a mosaic of vegetation successional stages across the landscape. This condition is more prevalent today than historically due to private land uses, and will likely remain so in the future under all alternatives. Alternative G would reduce this the most, but still would be well distributed relative to historic reference conditions.
Late- Successional Riparian	Historically, most riparian areas in the mountains were likely in mature forest. Native American uses created some early-successional habitat along larger streams and rivers that contained a wide floodplain. Today, these larger floodplains are dominated by agriculture or urban/suburban land uses. Most national forest riparian areas are in mature forest and will remain so into the future under all alternatives. This habitat element is rated Fair for distribution because we are considering the headwater areas that typically occur on national forest lands. The lower floodplains on private lands would be rated Poor.
Early-Successional Riparian	Quality early-successional riparian forests were present historically due to the effect of shifting Native American agriculture and settlement as well as natural flooding, fires and large ungulate grazing. Today these areas are rare on national forest and of poor habitat quality on private lands. Flooding effects have been controlled in many areas, fire has been excluded, and large floodplains developed. This habitat element would be created at very low levels on national forest under some alternatives and be supplemented to some extent on private lands, but likely would be less well distributed than during the historic reference period. These would be less well distributed under Alts G and E. Again, as in the late-successional riparian discussion, the distribution rating considers the headwater streams and riparian areas typically found on the national forest.
Snags	Distribution of forests with desired snag levels is a function of forest age and health. Increasing forest ages and numerous forest health threats indicate snags will be abundant and well
Downed Wood	This habitat element roughly follows trends of snags, however the habitat quality of downed wood is fair compared to historic conditions due to the loss of American chestnut in the ecosystem. Dead and down American chestnut was very rot resistant and persisted in the environment longer than the tree species that replaced them. Due to their persistence as downed wood, Eastern and Carolina hemlock are an important component of this habitat element today, especially within riparian areas, however these species are being eliminated by the hemlock wooly adelgid. In the short term, this will improve downed wood in national forest riparian areas, however their eventual loss will have a negative effect over the 50 year planning horizon. These effects would not vary by alternative.
Den Trees	Distribution of forests with desired densities of den trees is a function of stand age and tree diameter. Although den trees are expected to increase in abundance as the national forest ages, restoring an abundance of very large diameter den trees will require longer than 50 years of forest growth in many forest community types. Den trees, which generally need longevity to become high quality habitat elements for wildlife, are likely to be negatively affected by gypsy moth across all alternatives. These effects would not vary by alternative.

Table 3-97. Cont'd. Summary of outcomes by habitat element under different alternatives.

Hard Mast	Chestnut mast was historically dominant. Oak and hickory mast has replaced it at reduced levels. Levels are expected to remain reduced, especially due to additional impacts from gypsy
Remoteness	This condition was widespread historically and is dependent in large part on landscape context. Remote habitats are much reduced on private lands due to the prevalence of development, which is expected to increase in the future. In the rural counties immediately surrounding the national forest, development has been much less and is only expected to increase in counties near major population centers along the I-81 corridor. Remote habitats would remain widespread in the future on national forest lands under all alternatives, ranging from 37% of the Forest in Alternative G to 21% of the Forest in Alternative D. However, private land effects reduce distribution to fair.
Lakeshores	Forested lakeshores on the national forest are all a result of impoundments. There is only one natural lake in western Virginia and it is on private land adjacent to the national forest. These
Water Quality	Distribution of stream systems with high water quality has been reduced due primarily to private land uses, but is expected to remain common and high quality on national forest lands under all alternatives. One exception to this is the effect of air pollution, however the Forest works cooperatively with air management agencies and regional planning organizations to reduce impacts of air pollution to national forest resources. This would not vary by alternative.

Table 3-98. Number of species/habitat relationships rated as very high, high, and moderately high risk to species viability for each habitat element by forest plan revision alternative

Habitat Element	Alternative A	B	D	E	F	G	I
Bogs, Fens, Seeps, Seasonal Ponds							
Very High	36	36	36	36	36	36	36
High	18	18	18	18	18	18	18
Moderately High	17	17	17	17	17	17	17
Total	71	71	71	71	71	71	71
Open Wetlands							
Very High	2	2	2	2	2	2	2
High	2	2	2	2	2	2	2
Moderately High	4	4	4	4	4	4	4
Total	8	8	8	8	8	8	8
River Channels							
Very High	6	6	6	6	6	6	6
High	2	2	2	2	2	2	2
Moderately High	1	1	1	1	1	1	1
Total	9	9	9	9	9	9	9
Glades and Barrens							
Very High	16	16	16	16	16	16	16
High	7	7	7	7	7	7	7
Moderately High	8	8	8	8	8	8	8
Total	31	31	31	31	31	31	31
Carolina Hemlock Forests							
Very High	0	0	0	0	0	0	0
High	1	1	1	1	1	1	1
Moderately High	2	2	2	2	2	2	2
Total	3	3	3	3	3	3	3
Table Mountain Pine Forests							
Very High	0	0	0	0	0	0	0
High	1	0	1	1	1	1	1
Moderately High	1	1	1	1	1	1	1
Total	2	1	2	2	2	2	2
Spruce-Fir Forests							
Very High	22	22	22	22	22	22	22
High	9	9	9	9	9	9	9
Moderately High	4	4	4	4	4	4	4
Total	35	35	35	35	35	35	35
Beech Gap Forests							
Very High	0	0	0	0	0	0	0
High	0	0	0	0	0	0	0
Moderately High	0	0	0	0	0	0	0
Total	0	0	0	0	0	0	0
Basic Mesic Forests							
Very High	4	4	4	4	4	4	4
High	10	10	10	10	10	10	10
Moderately High	5	5	5	5	5	5	5
Total	19	19	19	19	19	19	19
Rock Outcrops and Cliffs							
Very High	0	0	0	0	0	0	0
High	15	15	15	15	15	15	15
Moderately High	14	14	14	14	14	14	14
Total	29	29	29	29	29	29	29

BIOLOGICAL ENVIRONMENT

THREATENED, ENDANGERED, SENSITIVE AND LOCALLY RARE SPECIES

TERRESTRIAL VIABILITY EVALUATION

VIABILITY EVALUATION RESULTS

Table 3-98. Cont'd. Number of species/habitat relationships rated as very high, high, and moderately high risk to species viability for each habitat element by forest plan revision alternative

Habitat Element	Alternative A	B	D	E	F	G	I
Spray Cliffs							
Very High	0	0	0	0	0	0	0
High	2	2	2	2	2	2	2
Moderately High	1	1	1	1	1	1	1
Total	3	3	3	3	3	3	3
Grassy Balds							
Very High	8	8	8	8	8	8	8
High	3	3	3	3	3	3	3
Moderately High	3	3	3	3	3	3	3
Total	14	14	14	14	14	14	14
Shrub Balds							
Very High	1	1	1	1	1	1	1
High	1	1	1	1	1	1	1
Moderately High	1	1	1	1	1	1	1
Total	3	3	3	3	3	3	3
Canebrakes							
Very High	0	0	0	0	0	0	0
High	0	0	0	0	0	0	0
Moderately High	0	0	0	0	0	0	0
Total	0	0	0	0	0	0	0
Caves and Mines							
Very High	0	0	0	0	0	0	0
High	10	10	10	10	10	10	10
Moderately High	4	4	4	4	4	4	4
Total	14	14	14	14	14	14	14
Mature Mesic Hardwood Forests							
Very High	0	0	0	0	0	0	0
High	0	0	0	0	0	0	0
Moderately High	27	27	27	27	27	27	27
Total	27	27	27	27	27	27	27
Mature High-Elevation Mesic Hardwood Forests							
Very High	0	0	0	0	0	0	0
High	0	0	0	0	0	0	0
Moderately High	14	14	14	14	14	14	14
Total	14	14	14	14	14	14	14
Mature Hemlock Forests							
Very High	5	5	5	5	5	5	5
High	3	3	3	3	3	3	3
Moderately High	3	3	3	3	3	3	3
Total	11	11	11	11	11	11	11
Mature Oak Forests							
Very High	0	0	0	0	0	0	0
High	0	0	0	0	0	0	0
Moderately High	3	3	3	3	3	3	3
Total	3	3	3	3	3	3	3

Table 3-98. Cont'd. Number of species/habitat relationships rated as very high, high, and moderately high risk to species viability for each habitat element by forest plan revision alternative

Habitat Element	Alternative						
	A	B	D	E	F	G	I
Mature Yellow Pine Forests							
Very High	0	0	0	4	4	0	0
High	4	0	4	1	1	4	4
Moderately High	1	4	1	1	1	1	1
Total	5	4	5	6	6	5	5
Early-Successional Forests							
Very High	0	0	0	2	0	2	0
High	2	2	0	2	2	2	2
Moderately High	2	2	2	5	2	5	2
Total	4	4	2	9	4	9	4
High Elevation Early Succession							
Very High	1	1	1	1	1	1	1
High	3	3	3	3	3	3	3
Moderately High	2	2	2	2	2	2	2
Total	6	6	6	6	6	6	6
Mature Forest Interiors							
Very High	0	0	0	0	0	0	0
High	0	0	0	0	0	0	0
Moderately High	0	0	0	0	0	0	0
Total	0	0	0	0	0	0	0
Canopy Gaps							
Very High	0	0	0	0	0	0	0
High	0	0	0	0	0	0	0
Moderately High	4	4	4	4	4	4	4
Total	4	4	4	4	4	4	4
Woodlands, Savannas, and Grasslands							
Very High	0	0	0	20	20	0	0
High	20	20	20	7	7	20	20
Moderately High	7	7	7	10	10	7	7
Total	27	27	27	37	37	27	27
Mixed Landscapes							
Very High	0	0	0	0	0	0	0
High	0	0	0	0	0	0	0
Moderately High	5	5	5	5	5	5	5
Total	5	5	5	5	5	5	5
Late Successional Riparian							
Very High	0	0	0	0	0	0	0
High	0	0	0	0	0	0	0
Moderately High	7	7	7	7	7	7	7
Total	7	7	7	7	7	7	7
Early-Successional Riparian							
Very High	3	3	3	3	3	3	3
High	2	2	2	2	2	2	2
Moderately High	2	2	2	2	2	2	2
Total	7	7	7	7	7	7	7

Table 3-98. Cont'd. Number of species/habitat relationships rated as very high, high, and moderately high risk to species viability for each habitat element by forest plan revision alternative

Habitat Element	Alternative A	B	D	E	F	G	I
Snags							
Very High	0	0	0	0	0	0	0
High	0	0	0	0	0	0	0
Moderately High	3	3	3	3	3	3	3
Total	3	3	3	3	3	3	3
Downed Wood							
Very High	0	0	0	0	0	0	0
High	0	0	0	0	0	0	0
Moderately High	14	14	14	14	14	14	14
Total	14	14	14	14	14	14	14
Den Trees							
Very High	0	0	0	0	0	0	0
High	1	1	1	1	1	1	1
Moderately High	0	0	0	0	0	0	0
Total	1	1	1	1	1	1	1
Hard Mast							
Very High	0	0	0	0	0	0	0
High	0	0	0	0	0	0	0
Moderately High	0	0	0	0	0	0	0
Total	0	0	0	0	0	0	0
Remoteness							
Very High	0	0	0	0	0	0	0
High	0	0	0	0	0	0	0
Moderately High	1	1	1	1	1	1	1
Total	1	1	1	1	1	1	1
Lakeshores							
Very High	0	0	0	0	0	0	0
High	0	0	0	0	0	0	0
Moderately High	0	0	0	0	0	0	0
Total	0	0	0	0	0	0	0
Water Quality							
Very High	0	0	0	0	0	0	0
High	0	0	0	0	0	0	0
Moderately High	1	1	1	1	1	1	1
Total	1	1	1	1	1	1	1
All Habitat Elements							
Very High	68	68	68	94	92	70	68
High	98	93	96	82	82	98	98
Moderately High	160	163	160	166	163	163	160
Total	326	324	324	342	337	331	326

Table 3-99. Number of species/habitat relationships rated as very high, high, and moderately high risk to species viability for each category of management effect by forest plan revision alternative

Management Effect	Alternative						
	A	B	D	E	F	G	I
Provide Optimal Protection and Management for All Habitat Occurrences							
Very High	64	64	64	64	0	64	64
High	65	65	65	65	10	65	65
Moderately High	62	62	62	102	5	102	62
Total	191	191	191	231	15	231	191
Improve Habitat Abundance and Distribution Through Restoration							
Very High	0	0	1	0	1	0	0
High	25	20	28	1	6	25	25
Moderately High	69	72	73	20	31	29	69
Total	94	92	102	21	38	54	94
Maintain Habitat Abundance and Distribution							
Very High	13	5	12	36	77	3	13
High	13	10	8	16	62	4	13
Moderately High	21	18	17	27	107	13	21
Total	47	33	37	79	246	20	47
Reduce Habitat Abundance and Distribution as Result of External Factors							
Very High	27	27	27	27	27	27	27
High	13	13	13	13	13	13	13
Moderately High	9	9	9	9	9	9	9
Total	49	49	49	49	49	49	49
Decline in Habitat Abundance and Distribution as Result of Management							
Very High	0	8	0	3	23	12	0
High	0	3	0	5	9	9	0
Moderately High	0	3	0	9	12	11	0
Total	0	14	0	17	44	32	0
Total for All Management Effect Categories							
Very High	104	104	104	130	128	106	104
High	116	111	114	100	100	116	116
Moderately High	161	164	161	167	164	164	161
Total	381	379	379	397	392	386	381

Table 3-100. Number of species/habitat relationships rated as very high, high, and moderately high risk to terrestrial species viability for each category of species status by forest plan revision alternative

Habitat Element	Alternative A	B	D	E	F	G	I
Federally Listed or Proposed as Threatened or Endangered							
Very High	4	4	4	4	4	4	4
High	4	4	4	4	4	4	4
Moderately High	5	5	5	5	5	5	5
Total	13	13	13	13	13	13	13
Regional Forester's Sensitive Species							
Very High	19	19	19	24	24	19	19
High	23	23	23	19	19	23	23
Moderately High	32	32	32	32	32	32	32
Total	74	74	74	75	75	74	74
Locally Rare and Other Species							
Very High	81	81	81	102	100	83	81
High	89	84	87	77	77	89	89
Moderately High	124	127	124	130	127	127	124
Total	294	292	292	309	304	299	294
Total for All Species Status Categories							
Very High	104	104	104	130	128	106	104
High	116	111	114	100	100	116	116
Moderately High	161	164	161	167	164	164	161
Total	381	379	379	397	392	386	381

Viability risk rating summaries indicate relatively small differences among alternatives relative to effects on species viability. This similarity results from planning efforts to include in all alternatives provisions to provide for species viability in compliance with NFMA regulations. Examples of such provisions common to all alternatives (except Alternative F, which represents the current forest plan) are the management prescriptions for Rare Communities (9F) and Riparian Corridors (11). Similarity of viability outcomes among alternatives also results from the influence of external forest health threats, which represent serious risk to forest communities and associated species regardless of alternative. Differences among alternatives are also muted by the small scale of actions contemplated under all alternatives relative the more extensive effects to ecological systems that have occurred to national forest landscapes since European settlement. Broader scale effects will likely continue to have similar important effects to species viability regardless of which alternative is selected.

Despite similarities, some differences in effects of alternatives are apparent. Alternatives E and G result in greater risk to more species than other alternatives primarily because they focus only on species that benefit from closed canopy, interior forest conditions. This focus results in reduced distribution and abundance of early successional forests and the important habitat they provide for several species at risk. Additional risks are incurred from the reduced distribution of mature yellow pine forests in Alternatives E and F due to the lower use of prescribed fire and wildland fire use. Alternatives A, B, D, and I provide more optimal mixes of habitats for the full range of species' needs.

Evaluation results indicate, under all alternatives, high levels of risk to species viability are associated with certain key habitats (Table 3-98). Highest risks are associated with early successional habitats, and mature yellow pine forests.

Of key interest are habitats elements that are both associated with high risk to species viability, and for which management can reduce risk by improving abundance and distribution (Table 3-99). Alternatives E and G provide optimal protection and management for all habitat occurrences of the most species, however this is done at the expense of other species so they also result in a decline in habitat abundance and distribution as a direct result of management for the most and third highest number of species respectively. Alternative F, on the other hand, maintains habitat abundance and distribution for the most species, but provides optimal protection and management for all habitat occurrences of the least species and also results in a decline in habitat abundance and distribution as a direct result of management for the second highest number of species.

Alternative B improves habitat abundance and distribution through restoration for the most species, closely followed by Alternatives D, A, and I. These four alternatives do not result in decline in habitat distribution and abundance for any species and they improve habitat abundance and distribution through restoration for more species than Alternatives E, F, and G.

Planning for, and evaluation of, species viability for forest plan revision has focused primarily on providing desired abundance and distributions of habitat elements, in compliance with NFMA regulations. Risks to species viability can be much reduced by additional provisions present in existing law and policy. These include specific consideration of effects to federally listed threatened and endangered species, those proposed for such listing, and Regional Forester's Sensitive Species; and in biological assessments and evaluations conducted as part of all national forest management decisions. These assessments and evaluations identify where additional protective measures are warranted to provide for continued existence of the species on national forest land. Projects that may affect federally listed or proposed species must be coordinated with the US Fish and Wildlife Service. In support of these requirements, these species are also often the focus of inventory and monitoring efforts.

Additional species-based provisions included in all Forest Plan alternatives supplement existing law and policy. All alternatives include general and species-specific provisions for federally listed species, developed through coordinated planning with the US Fish and Wildlife Service.

Table 3-100 shows that although there is not much difference in alternatives, E and G do result in a slightly high number of species or habitat relationships at risk. As mentioned previously, this is primarily due to those species that require active management in the form of early successional habitat or restoration of southern yellow pine communities. Those species that benefit from late successional forests and low disturbance are maintained under all alternatives, including Alternatives D and F which strive to restore a more balanced age class distribution. This is likely due to the fact that under all alternatives, there is a significant percentage of the Forest unsuitable for timber production (ranging from 57% of the Forest in Alternative D to 82% of the Forest in Alternative G).

In conclusion, differences in effects to viability risk among alternatives are relatively small. High-risk species/habitat relationships are primarily a result of historical influences that have reduced distribution and abundance of some habitat elements and species populations, and of future impacts from forest health threats. In general, effects of proposed management strategies are small relative to historical impacts and future external threats. In general, risks to species viability are minimized by forest plan revision alternatives that provide a balanced mix of low-disturbance and disturbance-dependant habitat elements. Some elements in this mix are best provided through passive management and protection, while others require active management for restoration and maintenance.

Slight differences in results presented here from those in the DEIS are primarily the result of updates to species' status information (F Ranks) made during the comment period through review and coordination with NatureServe and their contractors. Additional changes are the result of adding species inadvertently omitted from the DEIS, and in some cases, adjustments to habitat condition variables based on further analysis and interdisciplinary review. These adjustments have not resulted in substantial changes to overall patterns of risk, or conclusions relative to overall effects of alternatives. It is important to note that information on the status and ecology of this great diversity of species is constantly changing and will continue to do so as the revised Forest Plan is implemented. Lists of species of viability concern and related information will be maintained and updated as part of plan implementation; however, this updating will typically be small and incremental, and is not expected to change the overall conclusions of this analysis during the planning period.

AQUATIC SPECIES VIABILITY EVALUATION

National Forest Management Act (NFMA) 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). For planning purposes, a viable population is one that has numbers and distribution of reproductive individuals to insure its continued existence and is well distributed in the planning area. 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 persistence of the species over time.

Aquatic habitats are unique in that they are found in and adjacent to streams and lakes. The mobility of aquatic species is usually limited to these habitats. Habitat alteration is probably the major cause of decline of aquatic diversity in the South. Channelization, impoundment, sedimentation, and flow alterations are the most common physical habitat alterations associated with the decline of aquatic species (Walsh et al. 1995; Etnier 1997; Burkhead et al. 1997). Other human-induced impacts to aquatic species include pollution, introduced species, and over-harvesting (Miller 1989).

Habitat quality within a freshwater ecosystem is determined by activities within the watershed (Abell et al. 2000; Scott and Helfman 2001). Therefore, activities in these habitats, or waterbodies, can be described by similar areas of drainage to estimate the amount of suitable habitat. For administrative purposes these watersheds are described as 5th level hydrologic units (HUCs). The planning areas for aquatic species are 5th level hydrologic units or watersheds at the Forest Plan level.

It is estimated that over 500 aquatic species are found in the 250 watersheds associated with Region 8 forests in plan revision. It is impossible determine viability for each of these individual species. As a surrogate, the viability of proposed, endangered, threatened, sensitive, and locally rare (TESLR) aquatic species are assessed and threat to their viability determined. Other species with wide ranges are generally not at risk.

To determine if there is adequate habitat for these species, the condition of individual watersheds was determined. Watershed condition is determined from the physical and anthropogenic interactions within the watershed. Ideally, watershed condition would be determined from stream surveys. However, the extent and detail required to address all watersheds, including private land, with stream surveys is not available. To address habitat condition at the watershed level it is necessary to determine values from geographic data. These values were compared among the watersheds and a condition or set of conditions was determined.

VIABILITY EVALUATION PROCESS

SPECIES LISTS AND STRESSORS

A comprehensive list of aquatic species with potential viability concern was compiled for the Jefferson National Forest (Table 3-101). The species list and associated documentation can be found in Appendix F and the process paper *Aquatic Biological Resources*. The list includes those species found both on and downstream (within the 5th level HUC) from the National Forest in the following categories:

- Species listed as proposed, threatened, or endangered under the federal Endangered Species Act;
- Species listed on the Regional Forester's Sensitive Species list; and
- Species identified as locally rare on the National Forest by Forest Service biologists.

Each species was assigned one or more stressors. Four stressors were identified: sedimentation; point-source pollution; alterations in water temperature; and altered stream flows. Sensitivity to these stressors was assigned for each species, based on the published literature and personal communications (Terwilliger 1991; Etnier and Starnes 1993; Byron Freeman, Wendell Haag, Melvin Warren, Bernard Kuhajda, Stephen Hiner, and Arnold Eversole personal communications). Species sensitivity to the four stressors was compared with the condition of their respective watersheds to determine the threats to their persistence in the planning area. Threats to aquatic species viability are not limited to these four variables; however, GIS coverages are not available for channelization, introduced species, and over-harvest. For forest level planning it is assumed is that these four stressors adequately describe land disturbance activities in the planning area.

WATERSHED CONDITION

The watershed condition was assessed using metrics representing each of the identified stressors. The metrics were a compilation from geographic information layers. These layers include ownership, streams, roads, point sources, dams, and landuse from the 1970's and 1990's. The metrics and combinations of data used to determine the metrics are outlined in the following list:

1) Sedimentation (road density, road density in the riparian, forest cover (1970's and 1990's), and strip mines (average of 1970's and 1990's).

2) Point Source Pollutants (density of point sources).

3) Temperature (road density in the riparian area, and percent forest (1970's and 1990's) in the riparian area).

4) Altered stream flow (density of dams, road density in the riparian, and average density of strip-mines (1970's and 1990's).

BIOLOGICAL ENVIRONMENT

THREATENED, ENDANGERED, SENSITIVE AND LOCALLY RARE SPECIES

AQUATIC VIABILITY EVALUATION

AQUATIC VIABILITY OUTCOMES

In addition, a Watershed Condition Rank (WCR) was developed to characterize the condition (excellent, average, and below average) of 5th level watersheds with respect to current and predicted sediment loads. WCR characterizes cumulative effects of sediment from private and National Forest land within a specified watershed. It takes into account biological thresholds for sediment. The below average (BA) WCR ratings indicate that a biological threshold for effects from sediment is being reached. The WCR for this analysis was developed from data specific to Virginia and the surrounding area. As part of the watershed assessment, the WCR values were verified and adjusted according to local knowledge and data (see Water Resource Section).

COMBINATION OF WATERSHED CONDITION AND STRESSORS

To identify watersheds at risk the combined values for each watershed condition metric (sediment, point sources, temperature and altered flows) were multiplied against the presence (value of 1) of species of concern with corresponding stressors (see the Aquatic Biological Resources Process Paper). Watershed condition metrics with a score $\geq$ 2.51 (average or above for point sources, temperature and altered flows) and a WCR of excellent (for sediment) are assumed to have sufficient aquatic habitat at the watershed scale to maintain species viability.

Aquatic Viability Outcomes

Species of concern were related to the four environmental factors assessed in watershed analysis (point sources, water temperature, flow, and sediment). Separate viability outcomes were determined for each watershed where a species occurs, because in many cases watersheds support separate populations, and because factors affecting viability can vary considerably from watershed to watershed. Viability outcomes for each species by watershed were determined by incorporating elements of species distribution, abundance, and sensitivities to environmental factors; watershed condition relative to the species' environmental sensitivities; and the national forest role in the watershed. Viability outcomes are:

Outcome 1. Species occurs within watersheds with no impairment. Likelihood of maintaining viability is high.

Outcome 2. Species is potentially at risk in the watershed; however, Forest Service may influence conditions in the watershed to keep it well distributed. Therefore, likelihood of maintaining viability is moderate.

Outcome 3. Species is potentially at risk within the watershed; however, Forest Service opportunity to affect outcomes for the species in the watershed is limited. Therefore species viability in the watershed may be at risk.

Outcome 4. The species is so rare within the watershed (population is at very low density and/or at only a few local sites) that stochastic events (accidents, weather events, etc.) may place persistence of the species within the watershed at risk. Forest Service may influence conditions in the watershed to keep the species relatively secure. Therefore, likelihood of maintaining viability is moderate to low.

Outcome 5. The species is so rare within the watershed (population is at very low density and/or at only a few local sites) that stochastic events (accidents, weather events, etc.) may place persistence of the species within the watershed at risk. Forest Service ability to influence the species is limited. Therefore species viability in the watershed may be at risk.

A more complete discussion of the process and associated tables are found in the process papers: Aquatic Biological Resources and Sediment Yields and Cumulative Effects for Water Quality and Associated Beneficial Uses.

VIABILITY EVALUATION RESULTS

A summary of stressors and viability outcome by watershed for each species is found in Appendix F.

A summary of the species by number of watersheds with specific viability outcomes for all alternatives is in Table 3-101. The only change in WCR in any of the watersheds under all alternatives is for watershed 0505000201 and is shown in Table 3-102. The change is from average (A) to below average (BA) in alternative D, which would not result in a change in viability outcome. The species status codes are described as follows:

- T Federally Listed as Threatened
- E Federally Listed as Endangered
- C Candidate for Federal Listing
- S Forest Service Sensitive
- LR Locally Rare
- X Extirpated or Extinct

The viability outcome codes are described as follows:

- 1 -Species occurs within watersheds with no impairment. Likelihood of maintaining viability is high.
- 2 - Species is potentially at risk in the watershed; however, Forest Service may influence conditions in the watershed to keep it well distributed. Therefore, likelihood of maintaining viability is moderate.
- 3 - Species is potentially at risk within the watershed; however, Forest Service opportunity to affect outcomes for the species in the watershed is limited. Therefore species viability in the watershed is at risk.
- 4 - The species is so rare within the watershed (population is at very low density and/or at only a few local sites) that stochastic events (accidents, weather events, etc.) may place persistence of the species within the watershed at risk. Forest Service may influence conditions in the watershed to keep the species relatively secure. Therefore, likelihood of maintaining viability is moderate to low.
- 5 - The species is so rare within the watershed (population is at very low density and/or at only a few local sites) that stochastic events (accidents, weather events, etc.) may place persistence of the species within the watershed at risk.

Table 3-102. Number of watersheds with specific viability outcomes for each species found in watershed 0505000201 for Alternative D. See discussion for viability outcome definitions

Scientific Name	**Viability Outcome**					**Total**
	1	**2**	**3**	**4**	**5**	Watersheds
Aeshna tuberculifera	1		4			5
Arrhopalites commorus		1	2			3
Enallagma hageni			3			3
Etheostoma osburni		2	4			6
Somatochlora elongata			1			1
Stygobromus abditus	1		3			4
Sympetrum obtrusum			1			1

BIOLOGICAL ENVIRONMENT

Forest Service opportunities to affect outcomes for the species are limited. Therefore, species viability in the watershed is at risk.

THREATENED, ENDANGERED, SENSITIVE AND LOCALLY RARE SPECIES

AQUATIC VIABILITY EVALUATION

AQUATIC VIABILITY OUTCOMES

For the species that are in watersheds with viability outcome 2, the species are potentially at risk in the watershed because of one or more stressors; however, the species are actually on the Forest, and through riparian management prescription direction the Forest Service may positively influence conditions at those localized sites. Therefore, through proactive management where the species occur on National Forest land, the likelihood of maintaining viability in that watershed is moderate.

Watershed stressor and species viability associations are primarily a result of historical influences that have reduced distribution and abundance of some habitat elements and species populations. This viability analysis was based on the assumption that the riparian corridor width is that found in the tables in the riparian management prescription. In general, effects of proposed management strategies are small relative to historical impacts and future external threats. Risks to species viability are minimized by thorough riparian management prescription direction and standards, as well as applicable common standards.

Table 3-101. Number of watersheds with specific viability outcomes for each species for all alternatives except Alternative D. See discussion for viability outcome definitions

Scientific Name	Status	Viability Outcome					Total Water-sheds
		1	2	3	4	5	
Acroneuria kosztarabi	S			1		1	1
Aeshna mutata	LR			1			1
Aeshna tuberculifera	LR			5			5
Alasmidonta marginata	LR			4			4
Alasmidonta viridis	LR			1			1
Ammocrypta clara	S			1			1
Anax longipes	LR			2			2
Calopteryx angustipennis	LR	1		2			3
Cambarus veteranus	LR			1			1
Cottus baileyi	S			1			1
Cryptobranchus alleganiensis	LR		1				1
Cumberlandia monodonta	S			1			1
Cyprinella monacha	T			2			2
Cyprinella whipplei	LR			1			1
Cyprogenia stegaria	E			2			2
Dromus dromas	E			1			1
Elliptio crassidens	LR			2			2
Elliptio lanceolata	S	1		2			3
Enallagma hageni	LR			3			3
Epioblasma brevidens	E			2			2
Epioblasma capsaeformis	E			2			2
Epioblasma florentina walkeri	E			1			1
Epioblasma torulosa gubernacu-lum	EX			2			2
Epioblasma triquetra	S			2			2
Erimystax cahni	T			2			2
Etheostoma acuticeps	S			1			1
Etheostoma chlorobranchium	LR		1				1
Etheostoma osburni	S		2	6			8
Etheostoma percnurum	E			1			1
Etheostoma susanae	S			1			1
Etheostoma tippecanoe	S			2			2
Fusconaia barnesiana	S			3			3
Fusconaia cor	E			4			4
Fusconaia cuneolus	E			2			2
Fusconaia masoni	S	1		1			2
Gomphus descriptus	LR			1			1
Gomphus viridifrons	S	1		6			7
Hemistena lata	E			3			3
Hydraena maureenae	S			1			1
Ichthyomyzon greeleyi	S			2			2
Io fluvialis	S	1		3			4
Isoperla major	S			1		1	1
Lampsilis abrupta	EX			1			1
Lanthus parvulus	LR			2			2
Lasmigona holstonia	S	1		3			4

Table 3-101 Cont'd. Number of watersheds with specific viability outcomes for each species for all alternatives except Alternative D. See discussion for viability outcome definitions

Scientific Name	Status	Viability Outcome					Total Water-sheds
		1	2	3	4	5	
Lasmigona subviridis	S	1		8			9
Lemiox rimosus	E			2			2
Leptodea fragilis	LR			3			3
Leptophlebia johnsoni	S			1			1
Lestes disjunctus disjunctus	LR			1			1
Leucorrhinia intacta	LR			2			2
Lexingtonia dolabelloides	S			5			5
Ligumia recta	LR			3			3
Megaleuctra williamsae	S	1					1
Notropis ariommus	S			4			4
Notropis atherinoides	LR	1		1			2
Notropis semperasper	S	1		2			3
Notropis spectruculus	LR			3			3
Noturus gilberti	S	1		3			4
Ophiogomphus alleghaniensis	S			2			2
Pegias fabula	E			3			3
Percina burtoni	S			2			2
Percina macrocephala	S			2			2
Percina rex	E			2			2
Phenacobius crassilabrum	S			1			1
Phenacobius teretulus	S	1		3			4
Phoxinus cumberlandensis	T			2			2
Phoxinus tennesseensis	S		1	2			3
Plethobasus cyphyus	S			2			2
Pleurobema collina	E	1		4			5
Pleurobema cordatum	S			1			1
Pleurobema oviforme	S			2			2
Pleurobema plenum	E			1			1
Pleurobema rubrum	S			1			1
Ptychobranchus subtentum	LR			3			3
Quadrula cylindrica strigillata	E			3			3
Quadrula intermedia	E			1			1
Quadrula pustulosa	LR			2			2
Quadrula sparsa	E			2			2
Somatochlora elongata	LR			1			1
Sympetrum obtrusum	LR			1			1
Taeniopteryx nelsoni	S			1			1
Tallaperla lobata	LR			1			1
Toxolasma lividus	S			1			1
Truncilla truncata	LR			2			2
Villosa perpurpurea	E			1			1
Villosa trabalis	EX			1			1
Truncilla truncata	LR			2			2
Villosa perpurpurea	E			1			1
Villosa trabalis	EX			1			1

FOREST HEALTH AND PROTECTION

Beginning about 18,000 years ago during the peak of the last major glacial period, the forest communities of the Jefferson National Forest that we know today began to be shaped by global climate changes, indigenous human cultures, lightning, windstorms, beavers, large ungulates, and native insects and diseases. In the more recent past, European settlement and modern society have disrupted some of these natural processes (fire, beavers, and large ungulates) and introduced new disturbances like air pollution, gypsy moth, and hemlock woolly adelgid. The Southern Forest Resource Assessment (USDA Forest Service 2002) and the Southern Appalachian Assessment (SAMAB 1996) provide a vast amount of information regarding the history of native plant communities in the southeast. This section of Chapter 3 will focus on non-native invasive species, insects and diseases, wildland fire suppression, wildland fire use, and prescribed fire.

NON-NATIVE INVASIVE SPECIES

A multitude of non-native invasive species including non-native plants, insects, and pathogens threaten the integrity of native ecosystems in the southern Appalachian area. The Southern Appalachian Assessment (SAMAB 1996: 109) discusses a number of non-native invasive forest pathogen and pest organisms that have or are currently affecting the Jefferson National Forest. They are dogwood anthracnose, beech bark disease, butternut canker, dutch elm disease, chestnut blight, European gypsy moth, hemlock woolly adelgid, and balsam woolly adelgid. Non-native invasive aquatic species that are affecting or may affect the Forest are the Asiatic clam, zebra mussel, rainbow trout, and brown trout.

The Virginia Native Plant Society and the Virginia Department of Conservation and Recreation developed a list of non-native invasive plant species for Virginia. The non-native invasive plant species listed in Table 3-103 are considered to be currently or potentially troublesome for the Jefferson National Forest.

Direct and Indirect Effects

In 1999 the Southern Region released a Noxious Weed Management Strategy that outlined five emphasis areas: 1) Prevention and Education; 2) Control; 3) Inventory, Mapping, and Monitoring; 4) Research; and 5) Administration and Planning. This was followed in 2001 with the development of the Regional Forester's Non-Native Invasive Plant Species list (Table 3-104). The Final Environmental Impact Statement for Gypsy Moth Management in the United States, published in 1995, included the nation-wide Slow-the-Spread effort as a way to control this non-native invasive pest. The following Goals, Objectives, and Standards have been added to the Jefferson National Forest Plan to address the potential impacts of non-native invasive species.

Goal 14 (Plan) Contribute to maintenance or restoration of native tree species whose role in forest ecosystems is threatened by insects and disease. Management activities will reduce the impacts from non-native invasive species.

Objective 12.04 (Plan) Establish one American chestnut research and restoration sites across the forest in partnership with the American Chestnut Cooperators Foundation and the American Chestnut Foundation over the planning period.

Table 3-103. Non-Native Invasive Plant Species on the Jefferson National Forest

Common Name	Scientific Name
Tree-of-heaven	*Ailanthus altissima*
Garlic mustard	*Alliaria petiolata*
Japanese barberry	*Berberis thunbergii*
Butterflybush	*Buddleya davidii*
Musk thistle	*Carduus nutans*
Oriental bittersweet	*Celastrus orbiculata*
Spotted knapweed	*Centaurea maculosa*
Canada thistle	*Cirsium arvense*
Bull-thistle	*Cirsium vulgare*
Crown-vetch	*Coronilla varia*
Autumn olive	*Elaegnus umbellata*
Tall fescue	*Festuca elatior*
Gill-over-the-ground	*Glechoma hederacea*
Velvet-grass	*Holcus lanata*
Shrubby bushclover	*Lespedeza bicolor*
Chinese lespedeza	*Lespedeza cuneata*
Japanese honeysuckle	*Lonicera japonica*
Amur honeysuckle	*Lonicera maackii*
Morrow's honeysuckle	*Lonicera morrowii*
Tartarian honeysuckle	*Lonicera tatarica*
Purple loosestrife	*Lythrum salicaria and L. virgatum*
Japanese stiltgrass	*Microstegium vimineum*
Beefsteak plant	*Perilla frutescens*
Japanese knotweed	*Polygonum cuspidatum*
Mile-a-minute vine	*Polygonum perfoliatum*
Kudzu vine	*Pueraria lobata (P. montana)*
Multiflora rose	*Rosa multiflora*
Johnson-grass	*Sorghum halepense*
Japanese spiraea	*Spiraea japonica*
Periwinkle	*Vinca minor and V. major*

Objective 14.01 (Plan) Gypsy moth suppression priorities are:

- Where threatened, endangered, proposed, or sensitive species or their habitats may be negatively impacted by the gypsy moth;
- Rare communities likely to be severely affected by gypsy moth if no action is taken;
- Developed recreation areas and other concentrated use areas;
- Areas of high site productivity to maintain stump sprouting capability for oak regeneration in the short-term; resulting in long-term maintenance of hard mast production and forest diversity;
- Scenic byways and viewsheds; and
- Old growth forest communities.

Standard FW-35 (Plan) Control non-native invasive species where they are causing negative effects to threatened, endangered, or sensitive species. Do not intentionally introduce non-native species that are known or suspected of causing negative effects to

Table 3-104. 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
Albizia julibrissin	Silktree	*Alternanthera philoxer-oides*	Alligatorweed
Alliaria petiolata	Garlic mustard	*Ampelopsis brevipedun-culata*	Amur peppervine
Ardisia crenata	Scrated throat	*Arthraxon hispidus*	Small carpgrass
Berberis thunbergii	Japanese barberry	*Bromus inermis*	Smooth brome
Celastrus orbiculatus	Oriental bittersweet	*Carduus nutans*	Nodding plumelss thistle
Cinnamomum camphora	Camphortree	*Centaurea maculosa*	Spotted knapweed
Dioscorea alata	Water yam	*Cirsium arvense*	Canadian thistle
Dioscorea batatas	Air potatoe	*Cirsium vulgare*	Bull thistle
Dioscorea bulbifera	Chinese yam	*Coronilla varia*	Purple crownvetch
Eichhornia crassipes	Common water hyacinth	*Egeria densa*	Brazilian waterweed
Elaeagnus umbellata	Autumn olive	*Elaeagnus angustifolia*	Russian olive
Euonymus fortunei	Winter creeper	*Elaeagnus pungens*	Thorny olive
Hydrilla verticillata	Waterthyme	*Eragrostis curvula*	Weeping lovegrass
Imperata cylindrica (including I. brasiliensis)	Cogongrass	*Hedera helix*	English ivy
Lespedeza cuneata	Sericea lespedeza	*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	*Miscanthus sinensis*	Plume grass
Lolium arundinaceum * *(=Festuca elatior var. arundinacea)*	Tall fescue	*Myriophyllum spicatum*	Spike watermilfoil
Lonicera fragrantissima	Sweet breath of spring	*Nandina domestica*	Sacred bamboo
Lonicera japonica	Japanese honeysuckle	*Pistia stratiotes*	Water lettuce
Lonicera maackii	Amur honeysuckle	*Polygonum caespitosum*	Asiatic smartweed
Lonicera morrowii	Morrow's honeysuckle	*Polygonum perfoliatum*	Asiatic tearthumb
Lonicera tatarica	Tatarican honeysuckle	*Spiraea japonica*	Japansese meadow-sweet
Lygodium japonicum	Japanese climbing fern	*Vetiveria zizanioides* **	Vetiver grass
Lygodium microphyllum	Smallleaf 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 tomento-sus	Rose myrtle		
Rosa multiflora	Multiflora rose		
Salvinia molesta	Kariba-weed		
Sapium sebiferum	Tallowtree		
Schefflera actinophylla	Octopus tree		
Schinus terebinthifolius	Christmasberry		
Solanum viarum	Tropical soda apple		
Sorghum halepense	Johnsongrass		
Verbena brasiliensis	Brazilian vervain		

* = Applies only to endophyte-enhanced cultivars. All KY31 Tall Fescue is considered endophyte-enhanced.

** = Prohibition does not apply to sterile (nonflowering) cultivars of *V. zizanioides* federally listed threatened and endangered species in or near sites supporting these species.

Standard FW-85 (Plan) The use of Category 1 Species is prohibited.

Standard FW-86 (Plan) The establishment or encouragement of Category 2 Species is prohibited in areas where ecological conditions would favor invasiveness and is discouraged elsewhere. Projects that use Category 2 Species should document why no other (noninvasive) species will serve the purpose and need.

Standard FW-87 (Plan) Favor use of native grasses and wildflowers beneficial as wildlife foods when seeding temporary roads, skid roads, log landings and other temporary openings when slopes are less than 5%. On slopes greater than 5%, favor use of vegetation that best controls erosion.

Negative effects from non-native invasive species will be minimized under all Plan alternatives through the implementation of the above Goals, Objectives, and Standards.

Cumulative Effects

With an increased emphasis on the management of non-native invasive species, particularly plant species, it is expected that impacts from some of these species will be reduced from current levels on the Jefferson National Forest. Those species that respond well to treatment will be easier to control. Species, like autumn olive and Chinese lespedeza, have been planted to benefit wildlife. By not using these species in the future and controlling or eliminating them where they occur, we have a good chance of preventing their spread. However, some species are already so widespread and established that control is unlikely using currently available methods.

EUROPEAN GYPSY MOTH

The European gypsy moth, *Lymantria dispar* (L.), is a major defoliator of deciduous hardwood forests. This non-native pest was first introduced from Europe into Massachusetts in 1869, and because the favored host (oak) is widespread in the eastern deciduous forests, it thrived and continues to expand its range west and south each year. By the 1980's, the gypsy moth was established throughout the Northeast (SAMAB, 1996). The generally infested, or quarantine area, extends from New England, south into Virginia, west to Ohio, and includes all of Michigan. As of this writing, the area considered generally infested on the Jefferson National Forest by the gypsy moth includes the Glenwood, New Castle, and portions of the New River Valley Ranger Districts. Meanwhile the gypsy moth continues to move southward.

The gypsy moth completes a single generation each year. First instar larvae (caterpillars) emerge from egg masses in April or early May. As temperatures increase, the caterpillars leave the egg masses during daylight hours and climb into the forest canopy. Upon reaching the tips of branches, larvae may spin down on silken threads and disperse on the wind. Most larvae are dispersed within the local area, but some may be carried for distances greater than twelve miles (Taylor and Reling 1986). Larvae may repeat this dispersal process several times before settling down to feed. Male caterpillars usually pass through five larval instars (or, growth stages) and females pass through six. Larvae usually complete their development by early to mid-June and seek a sheltered location for pupation. The pupal stage lasts about 2 weeks at which time the adult emerges. The male adult moth is dark brown and bears several black bands across the front wings and are capable fliers. The female moth is nearly white, with black bands across the front wings.

Females cannot fly but they can walk short distances from their site of pupation. Females release a potent sex attractant (pheromone) to allure male moths for mating. Once mated, the female deposits her brood in a single mass of eggs and dies. The egg mass may contain from 75 to 1,000 eggs. Within four to six weeks, embryos develop into larvae within the eggs, overwinter, and hatch the following spring.

The gypsy moth spreads over relatively short distances by the ballooning of first instar caterpillars on wind currents. The insect also may spread over much greater distances via human transport. Long distance spread occurs by two mechanisms, the transport of caterpillars or the transport of egg masses. People may pick up larvae in infested areas and carry them on their vehicles, belongings, or clothing to uninfested forested areas. The transport of the gypsy moth via egg masses occurs when vehicles, equipment, or household belongings infested with egg masses are brought into an uninfested areas in the spring as the caterpillars are hatching.

Gypsy moth larvae feed on more than 500 species of trees, shrubs, and vines. Favored hosts include oak, apple, birch, basswood, witch hazel, and willow. Hosts moderately favored by gypsy moth include maple, hickory, beech, black cherry, elm, and sassafras. Least favored hosts include ash, yellow poplar, American sycamore, hemlock, pine, spruce, black gum, and black locust. Late instar larvae can feed upon tree species that younger larvae avoid, such as hemlock, maple, pine, and spruce. Feeding on less favored host plants usually occurs when high density larval populations defoliate the favored tree species and move to adjacent, less favored species of trees to finish their feeding and development. An individual gypsy moth caterpillar consumes the equivalent of approximately one square meter (10.75 square feet) of foliage during its development. A typical upland oak forest has 2.5 - 4.5 square meters of foliage per square meter of ground surface area. Thus, the feeding of a relatively few, healthy caterpillars can result in severe defoliation of oak in a stand.

Defoliation by the gypsy moth may induce oak decline in healthy trees, resulting in reduced growth of shoots and stem, dieback of the crown, a failure in hard mast production, and a sufficiently weakened tree such that it is attacked and killed by wood-boring insects and root disease fungi. Oaks in vigorous condition often can tolerate a year or two of defoliation before oak decline becomes pronounced. However, oaks that are stressed by pre-existing oak decline, drought, or some other factor tolerate defoliation less well. Tree mortality can be widespread and severe after a single defoliation under severe or compounding stress conditions. The damage caused by gypsy moth feeding in spring is harmful because trees must draw upon reserve carbohydrates and nutrients to produce a second canopy of leaves following defoliation (a process referred to as refoliation). Generally, a tree refoliates when approximately 60 percent of its canopy is consumed. Production of a new set of leaves following defoliation restores the photosynthetic capability of a tree's canopy, however, the refoliation process draws upon nutrient reserves that would be used for shoot growth and foliage production the following spring. The refoliated canopy is not able to fully replace the nutrients and stored reserves mobilized by the tree during refoliation, leaving the tree in a weaker condition the following spring. As a result, trees exposed to repeated defoliation and refoliation are weaker and more susceptible to attack by wood-boring insects and root-decay fungi.

Gypsy moth population densities fluctuate widely from year to year resulting in episodes of dramatic and severe defoliation followed by periods of relative innocuousness. At low densities, the gypsy moth is regulated, but not eliminated, by natural enemies such as parasitic insects and predaceous vertebrates, particularly small mammals. As populations increase beyond the control of these natural enemies, the gypsy moth is regulated by different mortality factors, primarily diseases and starvation. Of these two factors, diseases caused by the nucleopolyhedrosis virus (gmNPV) and the gypsy moth fungus (*E.*

maimaiga) lead to the collapse of outbreak populations of gypsy moth. At the forest stand level, the period between outbreaks may range from 2 to 5 years and the actual outbreak period may range from 1 to 3 years. On a region-wide basis, gypsy moth populations develop to outbreak levels across wide areas of the northeast, mid-Atlantic, and Lake States for a period of years and then drop to very low levels for several years. Factors regulating these regional outbreaks and collapses of gypsy moth populations are not well understood.

In response to concerns that the U.S. Department of Agriculture (USDA) was not adequately addressing the apparent increase in spread rates over the past three decades (Liebhold and others 1992), the USDA Forest Service (FS) in cooperation with Animal and Plant Health Inspection Service (APHIS); the states of Michigan, West Virginia, Virginia, and North Carolina; and the National Park Service, embarked on a pilot project called "Slow the Spread" (STS). The STS goal is to determine the feasibility of reducing the rate at which gypsy moth is spreading, by comprehensively implementing integrated pest management strategies over large geographic areas in the transition zone. The transition zone is located between the infested and uninfested areas and currently includes portions of the New River Valley District and Mount Rogers National Recreation Area of the Jefferson National Forest. As of this writing, evaluation of the STS project indicated that estimated spread rates significantly declined from an average of 16.5 miles per year prior to 1990 to 5.3 miles per year after 1990 (Sharov and Liebhold, 1998) and STS has been integrated into USDA's national management strategy for gypsy moth.

As the infested area of gypsy moth expands, the frequency of accidental introductions of gypsy moth on the Southern Appalachian Area national forests will increase. Increasing recreational use of national forest system lands may increase the number of accidental introductions of gypsy moth on Jefferson National Forest System lands. Accidental introductions of gypsy moth may lead to the use of insecticides to eliminate (or eradicate) and prevent the gypsy moth from becoming established on the Forest, especially in the STS area of the Jefferson National Forest. However, although STS will delay permanent establishment, it will not stop spread and the Jefferson National Forest will eventually become infested by gypsy moth and will be subjected to occasional outbreaks of this insect as populations increase regionally. Projections indicate that the Jefferson National Forest will likely be entirely infested by 2010 (SAMAB, 1996). However, continued implementation of the STS project on this Forest may delay that occurrence until 2025 (STS 2002). Defoliation may be extensive and severe when gypsy moth outbreaks do occur.

A gypsy moth risk rating system has been developed for use with the Continuous Inventory of Stand Conditions (CISC) maintained by the Jefferson National Forest. Entomologists at the Forest Health Protection field office in Asheville, NC developed this risk rating system. The model utilizes variables such as forest type, condition class, site index (a measure of site productivity) and age to assign a risk to each stand. Risks are categorized as Unaffected, Low, Moderate, High, or Extreme. This model was applied to the Jefferson National Forest CISC information. Table 3-105 displays the existing condition pertaining to these gypsy moth risks.

Thus, while almost one-third of the Jefferson National Forest is currently considered to be at no risk (unaffected) from gypsy moth impacts, primarily by virtue of ineligible forest types (that is, they contain a predominance of tree species immune or not preferred by the insect), two-thirds of the Forest has a moderate to extreme risk of experiencing gypsy moth-related impacts.

Table 3-105. Number of acres and percent of the Jefferson National Forest within 5 Gypsy Moth Risk categories

Risk Category	Acres*	Percent
Unaffected	187,000	27%
Low	44,000	6%
Moderate	172,000	24%
High	158,000	22%
Extreme	137,000	20%
Insufficient Data*	7,000	1%

* Note: Approx. 7,000 acres (1%) did not have sufficient data in CISC to calculate a risk.

Direct and Indirect Effects

While suppression and/or eradication of gypsy moth populations would be permissible under all Alternatives, the economic cost and concern for environmental impacts of widespread use of current treatment tactics, primarily the aerial application of insecticides, would result in only a very small amount of the Forest receiving such management actions. Generally, gypsy moth outbreaks on most Forest lands will not be managed actively and population outbreaks will be brought to an end through the action of natural control agents (primarily by disease epidemics caused by fungal and viral pathogens). However, where high value resources, such as developed recreation areas, are threatened with defoliation and damage, treatment with insecticides may be considered to manage gypsy moth populations and limit damage. The impacts associated with such treatments are well documented in the Final Environmental Impact Statement (FEIS) for Gypsy Moth Management in the United States: A Cooperative Approach. This document and associated Record of Decision (ROD) analyzes the impacts of various aerially applied pesticides on control of the gypsy moth, impacts to non-target organisms, as well as impacts to human health. The FEIS and ROD indicate that the use of suppression, eradication, and slow the spread treatments fully meet the USDA goal of reducing the adverse effects of the gypsy moth, addresses the major issues associated with gypsy moth and their treatment, and provides the greatest amount of flexibility in managing ecosystems affected by the gypsy moth. Means to avoid or minimize adverse non-target impacts due to gypsy moth treatment are discussed in Chapter 2 of that FEIS and have been adopted. The findings from this FEIS are hereby incorporated by reference. It should be noted that such treatments do nothing to alter the risk associated with a vegetative condition; they merely control the pest.

Oaks are a favored host species and their density is a primary indicator of the susceptibility of a stand to gypsy moth defoliation (Gansner and Herrick, 1985). Oak and mixed oak-pine forest types contain oaks at a high density and are therefore most susceptible to defoliation. Gypsy moth outbreaks may tend to be more frequent and the damage most severe where these stands occur in low-rainfall areas of the Forest. Hardwoods that are stressed by drought, oak decline, or some other factor tolerate defoliation less well (Witcosky, 2000). Furthermore, outbreaks occurring simultaneously with severe spring droughts often lead to relatively high levels of mortality (>15% mortality following a single year of severe drought and defoliation; 30% mortality following 2-3 years of severe drought and defoliation). Long-term detrimental changes in forest composition and structure following gypsy moth outbreaks will be most frequent under conditions corresponding to high oak decline risk; stands with a large red oak component (especially black and scarlet oak) of advanced age growing on soils with low moisture availability. Outbreaks that cause defoliation for 2-3 years in a row will lead to more severe levels of

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damage to affected stands and outbreaks that recur in the same stand after very short intervening time intervals will lead to greater levels of damage. Mast production may be reduced or fail in affected oak stands during and following gypsy moth outbreaks (Gottschalk, 1988).

As stated previously, factors that determine gypsy moth risk include forest type (oak density), site productivity (site index), age, and stand condition (condition class). Managers have no control over site productivity. Thus, species composition (forest type), stand condition, and age are the factors that managers can manipulate to alter the risk of gypsy moth impacts. Thinning and/or regeneration harvests can alter species composition and stand condition while only regeneration harvests can alter age of a given stand. Thus, our best tool in reducing the risk of receiving gypsy moth-related defoliation and/or mortality is vegetation manipulation through various types of timber harvesting.

By modeling oak and oak-pine community types on the Jefferson National Forest, we can obtain indications of how gypsy moth risk and forest management actions interact. In the absence of management we can expect approximately 5% of these community types to move from a moderate to a high risk by the end of the first decade. The percentage of these forest types in the low and extreme risk categories would remain unchanged, although minor changes in acreage within each category would occur. Approximately 63% of the oak and oak-pine community types on the Forest would have a high or extreme risk of gypsy moth impacts.

Harvesting of these stands in a timely fashion improves the risk of the stands in experiencing gypsy moth-related impacts. Harvesting can accomplish this goal through removal of susceptible host types (primarily oak trees) and/or altering the stand condition (removing weakened or decadent trees) during a thinning or other partial harvest. Regeneration harvests also have this affect while reducing stand age, thereby increasing stand vigor and ultimately reducing the vulnerability of the stand to gypsy moth-related mortality in the event of a defoliation event (adapted after Gottschalk, 1993.) The logical conclusion is that those alternatives that harvest more acres in upland oak and mixed oak-pine stands will have a more positive impact on reducing gypsy moth risk. Table 3-106 displays the acres estimated to be regenerated in these forest types by alternative.

Table 3-106. Average Annual Acres in the Oak and Oak-Pine Community Types regenerated through even-aged treatments by Alternative over the next 50 years

Activity	Alternative (Acres)						
	A	B	D	E	F	G	I
Acres Regenerated in Oak and Mixed Oak-Pine Forest Types.	1,300	800	2,700	100	700	200	900
Acres Thinned in Oak and Mixed Oak-Pine Forest Types.	800	300	300	500	80	60	400
Total Acres Managed in Oak and Mixed Oak-Pine Forest Types.	2,100	1,100	3,000	600	800	260	1,300

Based in part on the Desired Condition of the Alternative, an estimate of the above management activities' effects on the number of acres and percent of susceptible forest types within each risk category is presented. The focus of each alternative was used to estimate the percent of acres regenerated that would occur in each gypsy moth risk category. The base assumption is that the acres regenerated under each alternative would be equally distributed across all four gypsy moth risk categories. This assumption was then altered only for those alternatives where the focus would clearly change this distribution. For example, the focus of Alternative D is a balanced age class distribution and includes active control of insects. In this case, the total acres regenerated under Alternative D where allocated to acres of high and extreme gypsy moth risk. Conversely, Alternative E focuses on a variety of recreation opportunities and, in terms of forest health, emphasizes the maintenance of recreational experiences (e.g. user safety and visual quality). In this case the total acres regenerated were equally distributed across all risk categories.

Upon examining the results of Table 3-107, it is apparent that there is very little difference between the alternatives in altering gypsy moth risk after the first decade. The percentage of the oak and oak-pine community types in a high or extreme risk category range from 62% to 64% under all alternatives. Ten years is simply not enough time to seriously alter age class or species composition under any alternative. However, we begin to see how the alternatives vary in their effect on gypsy moth risk at the end of 50 years of management. Alternative D would have the greatest impact with approximately 60% of the community types in a high or extreme gypsy moth risk. This is consistent with Table 3-106 as Alternative D would regenerate the most acres of these susceptible community types. Alternative D would reduce gypsy moth risk better than any other alternative.

Alternatives A and F have a more moderate effect; approximately 67% and 68%, respectively, of the oak and oak-pine community types would be in a high or extreme gypsy moth risk. This is also consistent with the acres managed shown in Table 3-106 as these alternatives have a relatively high number of acres managed.

Alternatives E, G, B, and I have only a slightly less effect on gypsy moth risk; these alternatives range from 71% to 73% of the oak and oak-pine community types in a high or extreme risk category. It is interesting to note at this point that Table 3-106 and Table 3-107 do not necessarily agree, at least insofar as total acres regenerated. This is because of the way the acres regenerated were distributed across the four gypsy moth risk categories in the creation of Table 3-107. Even though Alternatives B and I would regenerate more acres than Alternative F, those acres regenerated would most likely be distributed evenly across all gypsy moth risk categories due to the focus of those alternatives. Conversely, since Alternative F focuses on balanced age class distributions, much like Alternative D, it is assumed that all of the acres regenerated would be in the high and extreme risk categories. Within this group of alternatives, Alternatives B and I would have the greater potential to reduce gypsy moth risk simply by virtue of the total number of acres managed in the oak and oak-pine community type. Alternatives E and G would be expected to have the least impact as compared to all other alternatives on reduction of gypsy moth risk.

Table 3-107. Percent of Oak and Oak-Pine Forests in 4 Gypsy Moth Risk Categories by the end of the First and Fifth Decades for each alternative

Risk	Alt A		Alt B		Alt D		Alt E		Alt F		Alt G		Alt I	
	10 yr	50 yr	10 yr	50 yr	10 yr	50 yr	10 yr	50 yr	10 yr	50 yr	10 yr	50 yr	10 yr	50 yr
Low	9%	10%	8%	7%	9%	12%	9%	8%	9%	9%	9%	8%	7%	7%
Moderate	29%	23%	28%	20%	30%	28%	28%	20%	29%	22%	28%	20%	19%	20%
High	36%	43%	37%	46%	36%	41%	36%	44%	36%	43%	36%	44%	43%	45%
Extreme	26%	24%	27%	27%	26%	19%	27%	27%	26%	25%	27%	27%	26%	27%

Cumulative Impacts

When considering actions on private and other agency lands within or directly adjacent to the Jefferson National Forest, cumulative impacts regarding gypsy moth risk are somewhat mixed. Lands administered by the National Park Service (Blue Ridge Parkway), the Army Corps of Engineers (John W. Flannagan Reservoir), and the Virginia Department of Conservation and Recreation (Hungry Mother, Breaks Interstate, and Grayson Highlands State Parks) are unlikely to be altered through vegetation management actions. Thus, gypsy moth risk can be expected to increase slightly (similar to that modeled for the Forest without action) on these acres, where the proper forest type exists, for all of the reasons described previously. However, since these areas focus so heavily on recreation, they are likely to suppress gypsy moth populations on relatively more acres. Since lands administered by these agencies comprise a very small percentage of the area as a whole, such suppression is unlikely to have any affect on populations dynamics of the general area. But, they may experience less gypsy moth-related impacts regardless of their vegetative condition simply due to repeated suppression activities on their lands.

Conversely, the Clinch Mountain State Wildlife Management Area does receive a degree of vegetation manipulation and is unlikely to receive a large amount of suppression efforts. Presumably, this area would be similar to the Jefferson National Forest Alternatives B and I with respect to the ability to reduce the risk of gypsy moth.

Management actions on privately held lands vary quite a bit depending upon the objectives and beliefs of individual landowners. Certainly those forested acres held by private industry are likely to be intensively managed and gypsy moth populations may be suppressed. The same is true for a notable segment of the small landowners in and around the Forest. Recent gypsy moth suppression activities and pre-salvage efforts ahead of defoliation have been occurring on many privately held acres. Both of these activities would result in a reduction of the incidence and risk of gypsy moth on these managed acres. However, many acres of privately held lands would remain unmanaged and likely increase the risk of gypsy moth-related impacts.

HEMLOCK WOOLLY ADELGID

The hemlock woolly adelgid, *Adelges tsugae*, an insect species native to Asia, was first identified in the eastern United States in 1924 in Richmond, VA, but it has recently expanded into the Southern Appalachians and threatens to spread throughout the ranges of eastern and Carolina hemlock. This non-native pest is currently established along the mountainous regions around the Shenandoah Valley, and is spreading southward along the Blue Ridge, and northward into New England. The adelgid may be spread by wind, birds, or mammals (McClure 1990). Long-range movement of the adelgid by migrating songbirds in the spring could explain why northward spread has been faster than southward spread. As of 1996, all of the SAA areas in Virginia, except for seven counties in the extreme western part of the Commonwealth, are now infested (SAMAB 1996). While the adelgid has continued to move south into North Carolina, it has not yet moved west into the Clinch Ranger District of the Jefferson National Forest (Forest Service 2000). All remaining Ranger Districts of the Jefferson National Forest are infested by the adelgid. Hemlocks in these areas are currently in various stages of damage and widespread mortality is evident, although the number of acres of mortality and/or damage is unknown at this time.

There are two species of hemlock in the SAA area, eastern hemlock (*Tsuga canadensis*) and Carolina hemlock (*Tsuga caroliniana*). Both species are included in the conifer-northern hardwood forest community type. The former is an important component of riparian ecosystems, providing cooling shade for streams, contributing nutrients for streams through litterfall, and providing winter shelter for wildlife. It may also be important as a feeding and nesting niche for neotropical migratory birds (Rhea and Watson 1994). Carolina hemlock, on the other hand, is less understood ecologically. It generally occupies more xeric sites on ridges and rock outcrops, but it also probably provides cover and nesting sites for birds and small mammals. Both eastern hemlock and Carolina hemlock are threatened by the adelgid.

Table 3-108 displays the distribution of the host type, hemlock forests, on the Jefferson National Forest. A total of approximately 13,500 acres of these host types are found on the Jefferson National Forest, comprising about 2% of the Forest. The highest concentration of the host type is located in the central ridge and valley portion of the Forest, although a small concentration is also located on the Glenwood Ranger District to the north. Conversely, the Clinch Ranger District has very little of this host type, perhaps explaining in part why the adelgid has yet to infest that portion of the Forest.

Table 3-108. Acres of Hemlock Forest Type by Ranger District on the Jefferson National Forest

Ranger District	Acres
Glenwood	1,500
New Castle	800
New River Valley	7,600
Mount Rogers	3,300
Clinch	250

Direct and Indirect Effects

Once infested by the adelgid, hemlocks are weakened, gradually lose their foliage, and are unable to refoliate or produce cones. Mortality occurs after complete defoliation, generally within 5 years of initial infestation (McClure 1987). There is no known genetic resistance to adelgids in either of the native Appalachian hemlock species, but resistance is known to occur in hemlocks native to Asia and in the two species native to the Western United States. Individual hemlock trees can be protected by spraying or soil treatments, but such treatment is impractical for forest trees (Rhea 1996). It appears that all untreated hemlocks, with the possible exception of small geographically isolated populations, could eventually be killed by the adelgid. Loss of hemlock will negatively impact riparian ecosystems and may result in a substantial reduction in habitat quality for birds and other wildlife (Rhea 1996).

On the Jefferson National Forest, horticultural oil has been used to reduce adelgid populations and impacts on about 12 acres in two developed recreation areas. This treatment is likely to continue under all alternatives. However, the impact of this treatment is inconsequential to the landscape scale of this analysis. The extremely small areas treated have negligible influence on the impacts of the adelgid or hemlock forests on the Jefferson National Forest.

Given the distribution of the host type across the Forest, extent of current adelgid infestation, and lack of effective control measures, we can expect all hemlock forests on the Jefferson National Forest to eventually become infested, if they are not already infested, deteriorate, and ultimately die. This impact would occur under all alternatives. The only exception to this impact might be the isolated hemlock forests on the Clinch Ranger District. These hemlock stands may be able to escape infestation due to their isolated nature.

Indirect effects may result in a loss of thermal insulation (summer cooling and winter insulation) along streams and riparian areas. In some areas, white pine may be able to fill this ecological niche, but it will take time for white pine to fully occupy the sites formerly held by hemlock. Loss of cover is likely to also adversely affect a myriad of bird and wildlife species on the Jefferson National Forest.

Cumulative Effects

The situation described above can also be applied to surrounding lands held by private interests and other agencies. The adelgid infests hemlock regardless of ownership and active management or the lack thereof has no influence on the pest or its impacts on the host. The very sad fact is that hemlocks throughout the Appalachian mountains of Virginia will continue to deteriorate and die and there is very little anyone can do about it at this time.

OAK DECLINE

Oak decline is a complex native disease involving interactions between environmental and biological stresses and subsequent attacks by insects and pathogens of opportunity. The disease generally progresses slowly over several years. It begins with a long-term predisposing stress such as prolonged drought or advanced age. These stressed or older trees are often subsequently damaged by short-term inciting factors such as insect defoliation, spring frosts, or acute drought. In their weakened condition, the trees may be attacked by insects and diseases that normally do not invade healthy trees. At this point, classic decline symptoms appear, beginning as dieback from branch tips inward and ultimately resulting in the death of the tree. The most important underlying factor when resource damage is severe may be a tree population dominated by senescent overstory oaks lacking vigor (Oak et al. 1991).

Oak decline is a serious forest health concern on upland hardwood forests in the Southern Appalachian National Forests. Stand and site factors that determine oak decline risk in the Southern Appalachians include forest type (oak density), site productivity (site index), age, and stress factors such as spring defoliation and drought or combinations of these stresses (Oak and Croll 1995). The highest risk conditions are stands with a large oak component (especially red oak of advanced age), growing on sites of average or lower productivity, with a recent defoliation history and prolonged growing season drought. Risk may be reduced by reducing stand age through regeneration harvests, altering species composition through thinning (reduce or eliminate oak component), and/or preventing stress factors (treating spring defoliating insects with insecticides is the only feasible option but is often not economically justifiable).

Oak decline is so pervasive in the Southern Appalachians that no reasonable alternative can adequately address risk at the landscape scale in the short-term. Management actions can lower risk locally and sustained effort over the long-term can gradually lower risk on more area. Based on SAA analyses, the Jefferson National Forest (along with the George Washington National Forest in Virginia) has the highest incidence of oak decline vulnerability and damage of all the Southern Appalachian Forests (SAMAB 1996).

An Oak Decline Event monitor has been developed for use with the Forest Vegetation Simulator (FVS) to model the interaction of vegetation management and the incidence of oak decline (Oak and Courter 2000). The risk of an oak decline event is but one of the many variables modeled by this program. Stands are categorized as either Not Eligible, Unaffected, Vulnerable or Decline Damaged (Oak and Croll 1995). Table 3-109 displays the distribution of the Jefferson National Forest within each of these oak decline risk categories estimated from all Forest Inventory and Analysis (FIA) plots located on the Jefferson National Forest as the input data to the FVS Oak Decline Event

Table 3-109. Percent of the Jefferson National Forest within 4 Oak Decline Risk categories

Risk Category	Percent of Forest
Unaffected	48%
Damaged (Other)	3%
Vulnerable	31%
Decline Damaged	18%

Monitor.

About half of the forested area is already damaged or vulnerable to oak decline. Most of the remaining area is in the unaffected category and covered by forest types that are ineligible for oak decline (e.g. predominately pine or northern hardwoods). Thus, nearly all of the oak dominated forest stands are either already damaged or vulnerable. Given this situation, the incidence of oak decline is expected to continue to increase across the Jefferson National Forest.

Direct and Indirect Effects

As stated previously, oak decline risk factors include forest type (oak density), site productivity (site index), age, and stress factors such as spring defoliation and drought or combinations of these stresses. Of these, managers have no control over site productivity and/or drought and little control over defoliating insects. Attempts to suppress insect pests over the entire, or even a significant part, of the landscape cannot be justified economically or environmentally. Thus, species composition (forest type) and age are the factors that managers can manipulate to alter the risk of oak decline. Thinning and regeneration harvests can alter species composition and only regeneration harvests can alter the age of a given stand. Thus, our best tool in combating oak decline is vegetation manipulation through various types of timber harvesting.

We can obtain indications of how oak decline risk and forest management actions interact by using FVS and the oak decline event monitor to model upland oak forest types on the Jefferson National Forest with ages of 60 years old or greater and site indices of 60 or better. In the absence of management we can expect an average net loss of about 500 cubic feet of volume per acre every decade. This loss is highest in the hardwood pulpwood product, but equates to about 70 cubic feet per acre per decade in both the High- and Moderate-Value Hardwoods. White Pine and Pine Pulpwood increase in volume in response to the additional growing space made available by the death of oaks. Average diameters are reduced by about 0.6 inches each decade due to the loss of large diameter oaks and recruitment of smaller diameter mid- and understory trees. Oak basal area is expected to be reduced by an average of 17 square feet per acre over the next 50 years. Approximately 19% of the upland oak stands 60 years old and older on site 60 lands or better can be expected to experience an oak decline event in any given five year period. Over a 50 year simulation, 18% of this vegetative condition would remain unaffected while as much as 53% would experience three or more oak decline events.

Harvesting of these stands in a timely fashion reduces the risk of oak decline. While rotation ages differ among the management prescriptions, generally speaking the black oak and scarlet oak stands are harvested at about 70 years of age and the remaining oak types at about 100 years of age. There is a vast improvement in oak decline risk when a shelterwood harvest leaving approximately 20% of the overstory trees is compared with no action under an oak decline scenario. Also, it is important to note that shelterwood harvests retain forest values best when the residuals are not decline-prone species, ages, or site classes. Black and scarlet oak stands experience a net gain of about 700 cubic feet per acre and an increase in average diameter of about 0.11 inches as compared to the same stands if they are not harvested. Similarly, other oak stands experience a net gain of about 950 cubic feet per acre but a decrease in average diameter of about 0.7 inches as compared to the same stands if they are not harvested. Net gains in cubic feet of volume result from harvesting the volume before it succumbs to oak decline-related mortality. Approximately 12-14% of the oak stands 60 years old and older on site 60 lands or better can be expected to experience an oak decline event in any given five year period. Overall, 61-63% of this vegetative condition would remain unaffected while only 11-13% percent would experience three oak decline events, and only 1% would experience more than three events, over the next 50 years.

This modeling exercise demonstrates the degree to which harvesting can forestall oak decline events through altering the age class and the vigor of a stand. The logical conclusion of this exercise means that those alternatives that regenerate more acres in upland oak, black oak, and scarlet oak stands will have a more positive impact on oak decline risk and the preservation of related forest values such as wildlife habitat, recreation, and wood products. Table 3-110 displays the acres estimated to be regenerated in each of those forest types by alternative.

Table 3-110. Approximate Average Annual Acres regenerated by oak Forest Type and Alternative over the Next 50 Year Period

Activity	Alternative						
	A	B	D	E	F	G	I
Acres Regenerated in Scarlet Oak Forest Types.	24	10	10	0	40	40	60
Acres Regenerated in Other Upland Oak Forest Types.	1,260	800	2,700	120	700	140	880
Total Acres of Upland Oak Regenerated (Rounded)	1,300	800	2,700	100	700	200	900

The ability to meet these activity levels will vary among alternatives due to the differences in management intensity and emphasis. To compare the potential level of upland oak regeneration activities among alternatives, the current distribution of oak and oak-pine forests within each prescription allocation was compared by alternative. Prescriptions were rated as to the management opportunity levels (none, low, medium, and high) they provide for the regeneration desirable to reduce the incidence of oak decline. The proportion of the existing oak forests in each management opportunity level is shown in Table 3-111.

Table 3-111. Proportion of Upland Oak Forests in Management Opportunity Level by Alternative for Jefferson National Forest

Alternative	Management Opportunity Level			
	None	Low	Moderate	High
A	45	13	30	12
B	55	7	34	4
D	39	3	19	40
E	60	27	11	2
F	41	2	21	36
G	66	13	20	1
I	54	5	34	7

Alternatives D and F would have the greatest potential for reducing the incidence of oak decline on upland oak sites since 57-59% of the existing acreage would have a moderate to high potential for regeneration activities; that is to alter the age class of the stands to a much younger age reducing the risk of oak decline events. This results primarily from the relatively larger allocation of the management prescription 10’s (Timber Production) under alternative D and a focus of balancing age classes under current management (Alternative F). However, while the actual projected acres of regeneration harvest (Table 3-110) rank Alternative D as the highest number of acres regenerated, Alternative A is ranked as second highest. Thus, Alternative A may be comparable to Alternative D in terms of ranking and reduction of oak decline risk. In any event, Alternative D would have the greatest benefit in terms of reducing the risk of oak decline.

At the other end of the spectrum, Alternative E has the least potential for regenerating acres and reducing oak decline risk where 87% of the upland oak types would have low or no potential for regeneration. Alternative E would also rank the lowest in terms of projected acres regenerated (Table 3-110). This results from the focus of this Alternative on recreation-related values and less vegetative manipulation. Alternative G has the second least potential for regenerating oak types and the second least projected acres of regeneration. This results from the Alternative's focus on maintaining large undisturbed areas. Neither of these alternatives would improve the oak decline situation on this forest. Indeed, Alternatives E and G represent a worsening decline situation as compared to the existing management direction (Alternative F), not just the lack of improvement.

Alternatives A, B, and I would have a more moderate positive impact on reducing the risk of oak decline on upland oak sites. These alternatives have a moderate to high potential for manipulation on 38% to 42%, of upland oak types. The projected acres of regeneration under Alternative I also rank in the moderate range, while the acres regenerated under Alternative A are more comparable to Alternative D (discussed above) Alternatives B and I would reduce the risk of oak decline somewhat.

Cumulative Impacts

In the description of the oak decline disease complex above, the role of both the long-term predisposing stress agent(s) and a short-term inciting agent was discussed. The entire Jefferson National Forest has been experiencing droughty conditions from 1999 through 2002. This, coupled with the advancing age of our oak forests, results in an existing condition that is ripe for serious oak decline incidence. The potential consequences of this condition have been illustrated in recent catastrophic decline episodes in the Ozark-Ouachita Highlands of Arkansas and Missouri during the past five years (Starkey and others 1999). The gypsy moth, an insect defoliator, has just begun to infest the northern portions of the Jefferson National Forest. More discussion on the gypsy moth and its impacts are disclosed elsewhere in this document, however it deserves discussion here as well. The gypsy moth is likely to be a short-term inciting agent that may trigger oak decline events as this insect moves south and west through the Forest. The combined effect of older aged oaks, past drought, and gypsy moth defoliation is likely to result in serious and widespread oak decline-related mortality of oaks.

When considering actions on private and other agency lands within or directly adjacent to the Jefferson National Forest, cumulative impacts regarding oak decline risk are somewhat mixed. Lands administered by the National Park Service (Blue Ridge Parkway), the Army Corps of Engineers (John W. Flannagan Reservoir), and the Virginia Department of Conservation and Recreation (Hungry Mother, Breaks Interstate, and Grayson Highlands State Parks) are unlikely to be regenerated through management actions. Thus, oak decline risk can be expected to increase dramatically where the proper forest types exist as stands age without regeneration, for all of the reasons described previously. However, the Clinch Mountain State Wildlife Management Area does receive a degree of vegetation manipulation. Presumably, this area would be similar to the Jefferson National Forest Alternatives A, B, and I with respect to the ability to reduce the risk of oak decline.

Conversely, management actions on privately held lands vary widely with the objectives and beliefs of individual landowners. Certainly those forested acres held by private industry are likely to be intensively managed and gypsy moth populations may be suppressed. The same is true for a notable segment of the small landowners in and around the Forest. Recent gypsy moth suppression activities and pre-salvage efforts ahead of defoliation have been occurring on many privately held acres. Both of these activities would result in a reduction of the risk of oak. However, many acres of privately held lands would remain unmanaged and likely increase in oak decline risk. Furthermore, the encroachment of residences in the urban/wildland interface results in a desire to keep older oak trees intact for aesthetic reasons. Unfortunately, construction of house foundations in proximity to such trees often creates another stress through disturbance of the root zone. Often, such trees ultimately die unless care is taken in protecting them during construction. Therefore, the increase in residences encroaching on the Jefferson National Forest near such areas as Roanoke and Blacksburg is likely to result in more oak decline incidence in the general area.

SOUTHERN PINE BEETLE

Southern pine beetle (SPB) (*Dendroctonus frontalis*) infestations have occurred cyclically throughout recorded history in the South. This is a native pest. SPB outbreaks move from low levels of infestation to high levels over several years. The cycles may be localized or regional and depend upon weather and other stress factors as well as the interrelationship between the populations of SPB and its predators.

The female SPB kills conifers by boring under the bark and destroying the cambium layer of the tree. They construct winding galleries while feeding and laying eggs. During outbreaks, trees are usually mass-attacked by thousands of beetles. The crowns of trees attacked by SPB during warm, dry weather may fade in color within weeks. Once a tree is successfully attacked, the tree usually turns light greenish-yellow, then yellow, and finally reddish-brown. This color change pattern can vary depending on the tree and environmental conditions.

SPB outbreaks in the SAA area are generally less dramatic than those on the Piedmont and Coastal Plain of the south because yellow pine forests types are less common in the Appalachian Mountains. SPB outbreaks have significant ecological implications, not only because of the loss of relatively scarce habitat, but because at least one yellow pine species, table mountain pine, is largely fire dependent. Table mountain pine stands killed by SPB rarely regenerate, and are permanently lost. To help land managers reduce stand susceptibility, hazard rating systems have been developed throughout the Southeastern United States. In the Southern Appalachians, the Mountain Risk System is recommended by most entomologists (Price 1994, SAMAB 1996).

A SPB Event monitor for use with the Forest Vegetation Simulator (FVS) has been developed to model the interaction of vegetation management and the risk of SPB outbreaks (Courter 2002). The risk of a SPB event is but one of the many variables modeled by this program. Stands are categorized as either Low, Moderate, or High Hazard. Table 3-112 displays the estimated percentage of the

Table 3-112. Number of acres and percent of the Jefferson National Forest within 3 SPB Risk categories

Hazard	Acres	Percent of Forest
Low	550,000	78%
Moderate	92,000	13%
High	63,000	9%

Jefferson National Forest within each of these SPB risk categories using all Forest Inventory and Analysis (FIA) plots located on the Jefferson National Forest as the input data.

Thus, a vast majority of the Jefferson National Forest is considered a low risk for SPB. Only about 22% of the Forest is considered to be of moderate or high risk. The cyclic nature of this pest results in population trends characterized by dramatic peaks punctuated by relatively long periods of inactivity. The Jefferson National Forest is currently in a low activity period and it is difficult to know when the next "peak" may occur.

Direct and Indirect Effects

Factors that determine SPB hazard include the proportion of the stand in susceptibility host trees (primarily the southern yellow pine species, although white pine can rarely be a susceptible species as well) and the radial growth of those trees over the past five years. Trees with a relatively high radial growth are less susceptible to SPB-related mortality. Managers can control both of these factors through vegetation manipulation activities. Thinning and/or regeneration harvests can alter both species composition and radial growth of the trees within a stand. Thus, our best tool in lowering SPB risk is vegetation manipulation through various types of timber harvesting.

By modeling pine and pine-hardwood forest types on the Jefferson National Forest with ages of 40 years old or greater and site indices of 50 or better, we can obtain indications of how SPB risk and forest management actions interact. In the absence of management we can expect an average net loss of about 228 cubic feet of volume per acre every decade. This loss is highest in the pine pulpwood product, but equates to about 51 cubic feet per acre in the Yellow Pine sawtimber product. Moderate and High Value Hardwoods increase in net cubic foot volume per decade. Pine basal area is expected to be reduced by an average of 65 square feet per acre over the next 50 years. Approximately 29% of the pine and pine-hardwood stands 40 years old and older on site index 50 lands or better can be expected to experience a SPB event in any given five year period. Overall, 11% of this vegetative condition would remain unaffected while as much as 66% would experience four or more SPB events over the next 50 years.

Harvesting, including both thinning of middle aged stands and harvest of rotation age stands, in a timely fashion improves the risk of the stands in experiencing SPB events. While rotation ages differ among the management prescriptions, generally speaking the pine and pine-hardwood stands are harvested at about 70 years of age. When we model a thinning at age 50 and a shelterwood harvest that leaves approximately 20% of the stand at age 70, we see a vast improvement in the SPB hazard scenario. Pine and pine hardwood stands experience a net gain of about 400 cubic feet per. Net gains in cubic feet of volume result from harvesting the volume before it succumbs to SPB-related mortality. Approximately 17% of the pine and pine-hardwood stands 40 years old and older on site index 50 lands or better can be expected to experience an SPB event in any given five year period. Although none of this vegetative condition would remain unaffected (all stands received a SPB attack in this run of the model), only 11% percent would experience four or more SPB events, and no stand would experience more than four events, over the next 50 years.

This modeling exercise demonstrates the degree to which harvesting can forestall SPB events through reducing pine density and maintaining vigorous radial growth. The logical conclusion of this exercise means that those alternatives that manage more acres in pine and pine-hardwood stands will have a more positive impact in reducing SPB hazard. Table 3-113 displays the acres estimated to be managed in each susceptible forest types by alternative.

Table 3-113. Average Annual Acres Regenerated or Thinned in Pine and Pine-Hardwood Community Types

Activity	Alternative A	B	D	E	F	G	I
Acres Regenerated or Thinned in Pine and Pine-Oak Community Types.	90	10	70	0	5	10	60

Alternative A would reduce SPB risk the most as it is projected to regenerate or thin the highest number of acres in the pine and pine-oak community types. Alternatives D and I would result in a moderate reduction in SPB risk relative to the other alternatives. The remaining alternatives would have minimal to no impact on the reduction of SPB risk relative to the other alternatives. In the context of overall reduction of SPB risk across the Forest, all alternatives would have minimal to no impact in reducing SPB risk.

Cumulative Impacts

When considering actions on private and other agency lands within or directly adjacent to the Jefferson National Forest, cumulative impacts regarding SPB hazard is somewhat mixed. Lands administered by the National Park Service (Blue Ridge Parkway), the Army Corps of Engineers (John W. Flannagan Reservoir), and the Virginia Department of Conservation and Recreation (Hungry Mother, Breaks Interstate, and Grayson Highlands State Parks) are unlikely to receive a great deal of vegetation manipulation. Thus, SPB events can be expected to increase dramatically on these acres, where the proper forest types exist, for all of the reasons described previously. However, the Clinch Mountain State Wildlife Management Area does receive a degree of vegetation manipulation. Presumably, this area would be similar to the Jefferson National Forest Alternatives D and I with respect to the ability to reduce the hazard of SPB attacks.

Conversely, management actions on privately held lands vary quite a bit depending upon the objectives and beliefs of individual landowners. Certainly those forested acres held by private industry are likely to be intensively managed and SPB outbreaks aggressively fought. However, many acres of privately held lands would remain unmanaged and likely increase in hazard of SPB outbreaks.

WILDLAND AND PRESCRIBED FIRE

The presence of fire begins long before humans arrived in North America. Evidence of lightning fires exists as fusain in coal layers and as lightning scars on petrified trees (Pyne, 1982). Even today, lightning and thunderstorms are abundant, and Pyne surmised, "A phenomenon of such magnitude and longevity has unquestionably kindled profound evolutionary consequences". This great and persistent selecting force has influenced ecosystem traits and characteristics since fuels and lightning first interacted. The result is a forest with diversity and flexibility that is well adapted to fire occurrence. Fire has no doubt been a major selection force in our forest ecosystems, both lightning and anthropogenic. Many communities and species require fire to sustain populations. Oak and southern yellow pine communities have been major components of these forests for thousands of years. These communities promote and require fire. Reoccurring fire has been a part of the ecosystem for thousands of years. Burning is the oldest sustained land management force on these forests. No other practice can be said to have such a track record with known results.

A clearer picture of change over time is gained when we focus on the period since the last ice age. Dramatic changes in plant and animal communities have occurred during this post-glacial period. Importantly, humans made their way onto the North American scene during this period. The ecosystems developed within the influences of both climatic and human forces. The question often debated is whether human ignition, for those thousands of years, should be considered when determining the “natural” state of ecosystems. Several points seem clear. The forests have been continually changing. The diversity and flexibility of these natural systems are necessary to react to change. Fire is an important mechanism to retain that diversity and flexibility.

Early human occupation of Virginia dates back to approximately 11,500 BP during the Paleoindian period (Barber, 1996). European contact was relatively early in the region of the George Washington and Jefferson National Forests, Barber (1996) notes European contact did not occur in the Ridge and Valley area until the 1670's, and the written historical record of fire is rich with accounts from travelers and explorers. The obvious conclusion, common to each account, was the extensive use of fire by Native Americans. The effect, likewise, was extensive. Early observations describe vast areas of grassy savannas, commonplace smoke and fire, clearings and fields and apparent utilization of fire-managed vegetation (Maxwell, 1910; Day, 1953; Pyne, 1982; Hammett, 1992; Brown, 2000). Maxwell contains a great number of accounts, but his perspective certainly reflects the bias and prejudices of the opponents to light burning. From all accounts, regardless of their perspective, burning by the Native Americans was a commonplace practice, serving many needs.

Methods of constructing fire histories in the east for pre-European settlement times have relied largely on sedimentary records (Craig, 1969; Watts, 1979; Patterson and Backman, 1988; Patterson and Sassaman, 1988; Wilkins et al., 1991; Kneller and Peteet, 1993; Patterson and Stevens, 1995; Delcourt and Delcourt, 1996). These studies typically extract a core of sediment from a pond or bog, and that core is then sampled for fossil pollen, plant macrofossils, sponge spicules, and/ or charcoal.

Though a scarcity of suitable sites has limited the amount of investigations, Ridge and Valley sinkholes have provided a number of valuable sites. Sites within or near the Forests are: Potts Mountain (Watts, 1979) in Alleghany County, south of Toms Knob, near Craig County; Hack Pond and Quarles Pond (Craig, 1969), southwest of Sherando, in Augusta County; Brown's Pond (Kneller and Peteet, 1993) in Bath County, near Williamsville; and another study that includes Brown's Pond and also Green Pond, in Augusta County, near Sherando Lake (Patterson and Stevens, 1995).

Common to each study is the dynamic nature of the composition of plant communities. Climate is the determinant mechanism that propels this continuum of change along a geologic time scale (Patterson and Backman, 1988). Fire acts within this continuum on a shorter scale, to provide an important catalyst that selects one plant over another. Watts (1979) agrees that this "migration of single species is an opportunistic response to changes in climate and environmental circumstances independent of other species". From 7,880 BP to the present, oak has been the dominant genus, comprising more than 50% of the pollen record. Pine is also present, increasing within this time period from 3% to 22%, with both white pine and yellow pines being represented. Chestnut stays below 1% until the upper, later half of the profile. The continued dominance of oak corresponds with relatively greater amounts of charcoal deposits. Blackgum was also found on Potts Mountain (Watts, 1979) during this period. Watts had also noted an earlier rise in Chestnut at Potts Mountain.

Patterson and Stevens (1995) correlated charcoal surface area to pollen abundance, signifying the relative importance of fire for sampled time periods. Brown's Pond (Bath

County) and Green Pond (Augusta County) were examined. Similar to other studies, they agree that the vegetation around Brown's Pond has changed little over the past 1,000 to as much as 4,000 years, with oak, hickory and chestnut representing important taxa. Also, ragweed was consistently present during this period, an indicator of agricultural activity.

Green Pond, on the other hand, showed a marked increase in total pine pollen, from <20% before the chestnut decline to over 40% more recently. Diploxylon pines (pitch and table mountain) are more important than at Brown's Pond. Also of significance is the recent reduction in oak pollen since the chestnut decline, from > 40% to less than 30%, suggesting local vegetative changes.

They then looked at the amount of charcoal surface area found, relative to the pollen samples. At Green Pond, evidence suggests fire presence both before and after European settlement. They determined that fire had a significant impact on vegetation around the time of European settlement. Those high charcoal values are followed by a sharp increase in pine pollen. This charcoal peak was between the increase in agricultural pollen and before the chestnut decline. The data suggests that fire in early post-European settlement resulted in a dramatic change in vegetation.

At Brown's Pond, high charcoal:pollen ratios appear at 650 years BP, ~2,000 BP, and 4,210 years BP. The average ratio prior to European settlement is slightly higher than post-settlement, with two fires clearly evident since Euro-settlement. The higher pre-euro-settlement values indicate the long historical role fire has played in the hardwoods. The authors suggest that long interval fire regimes have been important in maintaining the vegetative composition typical of the central Appalachians.

Patterson and Sassaman (1988) compared amounts of sedimentary charcoal to archaeological sites and found that fires were common near larger Native American 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).

Delcourt and Delcourt conclude by stating, "If management goals of the U.S. Forest Service include maintaining populations of fire-adapted pines and certain oak species that are currently declining because of active fire suppression, then future management tools clearly must include prescribed burning. The lesson from the Horse Cove example of prehistoric human use of fire is that fires of limited extent, focused on particular portions of the landscape, and excluded from others, can promote a heterogeneous mosaic of different vegetation types, some of which include clearly fire-adapted species, and others of which include fire-intolerant species. In order to maintain both old growth mesic hardwoods and fire-adapted pines within the same forest district, an optimal management plan would be based upon an understanding of the effects of different frequencies and intensities of fire applied to varying portions of the topographic-edaphic gradient and different areal extents of impact. Work of vegetation ecologists such as Runkle (1982, 1985) and Barden (1980, 1981) indicates that equilibrium, old growth mixed mesophytic forests will regenerate only under a disturbance regime that includes infrequent windthrow to open canopy gaps but which explicitly excludes fire (see also Clark and Royall, 1996). Promotion of Appalachian oak forests, including relatively widely spaced oak groves or "oak orchards" with sparse understory of grass and bracken fern (Stephenson et al. 1993), on the other hand requires use of frequent ground fires such as may have been used by prehistoric Native Americans to maintain their hunting and gathering grounds. Furthermore, periodic crown fires along exposed ridge crests may be necessary for regeneration of fire-adapted endemic pine species".

The Jefferson National Forest was established in 1936 and 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. The use of fire fighting equipment, intelligence, weather forecasts, budgets and fire behavior prediction have only recently enabled prescribed burning 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.

Several other studies have approached the issue of fire occurrence, what it has been in the past and the implications of fire exclusion.

Sutherland et al., 1993, sought to “reconstruct the historical relationship between fire and community structure using both the age and species composition approach in combination with tree-ring fire history analysis”. Their study, on Brush Mountain in southwest Virginia, noted the loss of Table Mountain pine (*Pinus pungens*) recruitment since fire suppression in the late 1930’s. Major recruitment of *P. pungens* occurred twice during the 1800’s, probably due to exceptionally hot fires. The fire scar chronology indicated that fire occurred frequently (every 9-11 years) throughout the 19th century and early 20th century. Most of those fires occurred during the dormant season, most likely in early spring. The hot recruitment fires may have been during the growing season. They stated, “Fire suppression is most likely the cause of a dramatic change in the composition of the Brush Mountain communities during the last 60 years (Williams and Johnson, 1990). In the past, fire clearly promoted integrity of the *Pinus pungens* community on Brush Mountain”.

Dendropyrochronology studies provide valuable information such as the season of fire occurrence since trees lay down early season and late season wood in each tree ring per year; the number of fire scars on an individual tree provides data on fire frequency; and, by cross dating fire scars on different trees that occurred in the same year one is able to approximate the spatial extent of a fire.

WILDLAND FIRE SUPPRESSION

Fires generally fall into one of two categories: wildland fires or prescribed burns. A wildland fire is a fire resulting from an unplanned ignition; it requires an appropriate management response to control its spread. A prescribed fire is any fire ignited by management actions to meet specific objectives. Escaped fires are a third category. An escaped fire is a prescribed fire that exceeds its prescription or a wildland fire that exceeds the initial level of control actions and requires re-evaluation through a Wildland Fire Situation Analysis.

In Adam's study of wildland fire records on the George Washington National Forest, he found that, between 1915 and 1993, there were 2,198 fire records on file. The vast majority (76%) were small fires less than 10 acres. Only 1% of the fires were greater than 1,000 acres. Early records, prior to 1950, are incomplete, but several significant trends can be determined. Nearly 40% of the fire starts were attributed to arson and smoking. An additional 14% were of unknown origin. Lightning accounted for 13.2% of all fires. Though this data is from in-service records of fire reports, it is assumed to accurately reflect trends in the data. The study also shows a typical spring and fall fire season, attributed mostly to human starts. Lightning fires appear normally distributed throughout the summer. During the 15 year period, 1987 through 2001, lightning fires accounted for 19% of all fires while the remaining 81% were attributed to human causes, with arson accounting for 36% of the total fire workload. During that same period the statistics were nearly identical as what Adam's had found, 73% of all fires were 10 acres or less and only 1% of all fires reached 1,000 acres in size or greater. Since suppression action was initiated on all the wildland fires, there is no conclusive way to now accurately predict how large the fires would have become had suppression action not been taken. This information would assist in helping managers apply prescribed fire to the various forested ecosystems at levels to mimic the role of what naturally occurred. In the late 1990's a computer simulation model, FARSITE, was developed that can predict fire spread based on actual observed weather and fuel conditions. The simulation can be run to determine how closely it modeled the observed results. The model is data intensive and requires 8 spatial inputs from GIS to identify topographic and vegetative conditions: weather and wind data; ignition location and duration and space and time resolution i.e. simulation parameters. As with all models there are certain limitations and assumptions that are made, FARSITE assumes fires burn in an elliptical pattern, fire shape is determined by the wind and slope and its size is determined by the rate of spread.

Fire is a random event and is therefore unpredictable as to its spatial occurrence. During spring and fall fire seasons, arson is the leading cause of our wildland fire starts. Though we may know the area an arsonist is working, the next start is always an unknown. Law enforcement officials on the George Washington and Jefferson National Forests have been very successful in recent years in apprehending and prosecuting a number of arson cases on the forests that have led to prison sentences. We may be able to reduce, to a degree, human-caused fires through active fire prevention, education, and enforcement programs. The second leading cause of wildland fire starts is lightning. Lightning is an extremely random event that is dependent upon the weather systems that occur. Arson and lightning together account for 55% of the wildland fire occurrence during both of the Forests' fire seasons for the 15 year period 1987-2001.

Table 3-114 shows the fire history for 1987-2001 for both the George Washington and Jefferson National Forests for spring and fall fire seasons only. The forests also suppress fires that occur outside our normally staffed fire seasons but those statistics are not included in this table nor are those fires included for funding purposes. The largest lightning fire on the Jefferson National Forest during the 15 year time period was 382 acres and occurred on the Glenwood Ranger District in March of 2000. The largest human-caused fire during that same time period was 2,151 acres and occurred on the New Castle Ranger District in April of 1995. The average number of fires per year during the time period was 44 and the average acres burned were 1,475.

Generally, southern aspects had higher occurrences. Human-caused fires began largely on the lower slopes (following road and settlement patterns) and lightning was distributed on the higher slopes.

Volunteer Fire Departments (VFD's) gradually assumed the role of the local, less formal warden crews. VFD's are well-distributed through the valleys and are trained, equipped

Table 3-114. Wildland Fire History for the George Washington and Jefferson National Forests

Year	No. of Fires by Cause Lightning	Human	Total No. of Fires	Acres Burned
1987	9	27	36	267
1988	21	59	80	1,129
1989	4	20	24	318
1990	2	23	25	511
1991	4	30	34	1,666
1992	2	13	15	175
1993	7	14	21	347
1994	8	27	35	271
1995	3	49	52	5,718
1996	2	20	22	89
1997	6	37	43	1,013
1998	7	52	59	3,818
1999	30	59	89	2,028
2000	16	43	59	2,127
2001	6	61	67	2,650
Total	**127**	**534**	**661**	**22,127**
Average			**44**	**1,475**

and quick to respond. Their rapid response has kept most roadside fires to minimal acres. Not all areas of the Appalachians have this committed response. VFD's have, no doubt, prevented many wildland fires from involving homes and structures.

The firefighting organization continues to evolve, as interagency and intra-agency cooperation multiplies available resources, communication improves, and aircraft is utilized. The Jefferson National Forest is combined with the George Washington National Forest for its National Fire Management Analysis System (NFMAS) initial attack modeling for the planning and developing of the forest fire suppression and prevention program. The results of this latest analysis have provided the forest with additional full-time Zone Fire Management Officers, Assistant Zone Fire Management Officers, a Helicopter, Type 6 engines and a fire-funded bulldozer.

Firefighter and public safety is always the primary consideration for all suppression strategies and tactics. The full range of appropriate management responses from direct attack to monitoring a fire are available to the fire manager and line officer. Strategies and tactics for the fire should be commensurate with resource values at risk. Natural barriers such as rock slides, riparian areas, roads, etc. are used whenever possible to construct firelines to mitigate impacts to soil, vegetation and water; reduce costs of line construction; and to provide for additional safety considerations. Once the forest has an approved Fire Management Plan for areas that have been identified as suitable within this Land and Resource Management Plan, then Wildland Fire Use will become an option for the management of natural i.e. lightning ignitions. While wildland fires may not be managed to meet resource objectives, Wildland Fire Use fires may be managed to meet resource objectives once a Wildland Fire Implementation Plan (WFIP) is written for the fire. The Fire Management Plan (FMP) is the implementation guide for the Fire Management program on the National Forest. The FMP describes in detail the fire suppression organization, the prescribed fire program, smoke management concerns and guidelines, the prevention program and all other relevant aspects of the Fire Management program.

The Jefferson National Forest is relatively fragmented and therefore is adjacent to private land along much of its boundary. There is increasing pressure as additional growth occurs in these areas. More people desire to live in wooded surroundings and typically work at maintaining a natural vegetative state surrounding their property to provide a more isolated setting that will block the view of any adjacent structures. While this is aesthetically pleasing, the increased vegetation can quickly become hazardous fuel in the event of a wildland fire. From a suppression standpoint, anytime there is a wildland fire in the wildland urban interface, more resources respond with a threat of structure involvement. These fires are much more expensive to suppress and are almost always multi-jurisdictional.

Wildland fires occurring in the wilderness use MIST (Minimum Impact Suppression Techniques) techniques for fire suppression operations. Safety is still the primary consideration though when selecting strategies and tactics, tools and equipment, we utilize those that will have the least impact on the environment. Strategies that allow the fire to burn to natural barriers are favored and if fireline must be constructed, then it should be of a minimum width and depth to check fire spread. Limbing, bucking, and felling of trees or snags are minimized unless they are a safety hazard or threaten security of the fireline and then are only removed to a level to prevent additional fire spread.

FUELS MANAGEMENT

For fiscal years 1998 through 2002, the Jefferson National Forest prescribed burned a total of 14,754 acres ranging from a low of 994 acres in 2000 to a high of 5,355 acres in 1998. Factors such as yearly fuels funding allocations, appropriate weather conditions, and the availability of qualified prescribed fire personnel and helicopters play a critical role in determining how many acres may be prescribed burned in any given fiscal year. The Jefferson National Forest typically conducts its prescribed burn operations between late February and early May. All prescribed burn projects must have a NEPA analysis completed and a burn plan prior to burn implementation. The burn plan contains specific burning objectives and parameters under which the burn will be conducted to meet specific on the ground resource management objectives.

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. In a research burn conducted in the Blue Ridge Experimental Forest in Macon County, NC, (Clinton, Vose, Swank, Berg and Loftis, 1998) more than 50 percent of the mass in litter and small wood was lost during burning. In this study, both fire intensity and severity were moderate. In addition to fire behavior, fuel size and flammability were important determinants of fuel mass consumption. Small wood is more completely consumed at lower temperatures than larger wood, plots high in wood mass in small size classes would lose more mass than plots with similar mass in larger size classes. Burning conditions that produce a more intense fire i.e. longer flame lengths with shorter residence times which equates to a lower severity fire with higher rates of spread would consume less of the humus layer and the associated nutrients though overstory mortality could become an issue dependent upon the type of commercial harvest method. Thus, this proves a strong case for using prescribed burning to treat the resultant slash from commercial harvest operations. Small logging slash, primarily in the form of foliage and fine branches, although temporarily dangerous as a fuel carrier in the case of an ignition, are a short-term problem, often decomposing within the first 4-5 years by white rot fungi in warm, moist environments according to Harvey et al. On the Jefferson National Forest, logging contractors leave tops cut at 4" DBH left where the tree was fell and the rest of the logging slash is lop and scattered to decay more quickly which consequently lessens the threat of a fire threat and distributes the fuel more evenly so if a fire did occur, or a prescribed fire were utilized to treat the slash, the fire severity would be lower and less intense. The EPA states, in their 1998 policy document entitled Interim Air Quality Policy on Wildland and Prescribed Fires, that while future air quality concerns from prescribed fire may arise, the EPA is on record stating that fire should function, as nearly as possible, in its natural role in maintaining healthy wildland ecosystems and to protect human health and welfare by mitigating the impacts of air pollutant emissions on air quality and visibility.

Prescribed fire and mechanical fuels treatments are designed to reduce the risk of catastrophic wildland fires 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. Since 2001 when the National Fire Plan (NFP) was implemented, there has only been one mechanical fuels treatment completed on the Jefferson National Forest. A couple of reasons for the low number of completed mechanical treatments are the high cost per acre of the treatments, mechanical treatments are almost 10 times the cost of prescribed burning, most projects range in size from 20 – 70 acres in size so they are usually much smaller and are much more labor intensive hence the higher cost per acre. Examples of mechanical fuels treatments are lopping and scattering of branches of larger diameter trees, thinning of small diameter saplings and the mastication or mowing of large grassy openings. 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 non-native invasive 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.

Table 3-115 contains 27 years (1967-1993) worth of data (660 fire records) from the Jefferson National Forest where 80% of the fire reports had forest type information recorded. For the remaining 20% of the records, a weighted average was used based on the forest types that had been recorded. Additionally, 2,284 fire reports from the George Washington National Forest were analyzed and included in the table since it lies within the same physiographic province and therefore the same community types exist across both units. The George Washington National Forest data was more extensive as four districts had data from 1921-1995, one district from 1915-1995 and one district from 1950-1995 so an average of 60 years was used to determine the weighted average for determining forest type for those fire reports where none was identified. Thirty-eight percent of the records did have a forest type identified and it should be noted that prior to 1975 forest type was not indicated on the fire report. Forest type is more indicative of site index so a crosswalk was developed to Old Growth Community Types. Of the Old Growth Community Types identified for the forest, only five of the nine had fires based on the fire reports those being: River Floodplain and Eastern Riverfront Forests Combined; Dry-Mesic Oak; Dry and Xeric Oak, Woodland and Savanna; Xeric Pine and Pine Oak; and, Dry and Dry Mesic Oak-Pine. Rarely do fires occur in the other community types and the acre calculations are best estimates.

Table 3-115. Fire Regimes for Forest Communities on the Jefferson National Forest

Forest Community Type	Mean Fire Return Interval in Years	Intensity[1]	Severity[2]	Acres Expected to Burn Annually
Northern Hardwoods	100-250	Low	Low	0-1
Conifer-Northern Hardwood	100-250	Low	Low	0-5
Mixed Mesophytic	80-200	Low	Low	0-10
River Floodplain and Eastern Riverfront Forests	60-150	Low	Low	0-22
Dry-Mesic Oak	10-20	Moderate	Mixed	0-721
Dry and Xeric Oak, Woodland and Savanna	5-15	Moderate	Mixed	0-828
Xeric Pine and Pine Oak	2-10	Moderate	Mixed	0-744
Dry and Dry Mesic Oak-Pine	10-20	Moderate	Mixed	0-653
Montane Spruce-Fir	100-250	Low	Low	0-1

[1] Intensity is defined as the upward heat pulse produced by the fire (Ryan and Noste 1985).

[2] Severity reflects the amount of heat released and is indicated by fuel consumption.

The Jefferson National Forest uses both prescribed fire and mechanical treatments to reduce fuel loading, to break-up fuel continuity (both vertically and horizontally), and 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.

Prescribed fire is also a valuable tool to provide wildlife habitat; for managing rare communities that require periodic fire to maintain plant viability; for Diploxylon pine species such as pitch and table mountain pine; for a silvicultural site preparation tool; for increasing forage; and for regenerating oak stands on highly productive sites (Brose and Van Lear 1999). Table 3-116 displays the acres of prescribed fire by Alternative and by type of burn in an average year over the next decade.

Table 3-116. Acres of Prescribed Fire by Alternative

Alter-native	Acres By Type of Burn (Based on an Average Year in First Decade) Xeric Forests and Woodlands		Balds and Grasslands		Dry and Dry-Mesic Forests		Silvicultural Treat-ment for Oak Re-generation		Total Acres	
	Min	Max	Min	Max	Min	Max	Min	Max	Min	Max
A	2,920	3,670	750	750	6,100	7,670	1,590	2,000	11,360	14,090
B	3,320	5,230	320	320	6,940	10,940	1,810	2,850	12,390	19,340
D	2,950	3,890	750	750	6,160	8,130	1,610	2,120	11,470	14,890
E	2,380	2,640	750	750	4,970	5,510	1,300	1,440	8,420	9,400
F	320	600	750	750	670	1,250	170	330	1,910	2,930
G	3,050	4,320	0	0	6,380	9,040	1,670	2,360	11,100	15,720
I	3,000	3,910	750	750	6,270	8,180	1,640	2,130	11,660	14,970

The maximum prescribed burn acres by alternative were calculated for four fire-dependant Old Growth Community Types (OGCT): 1) Dry-Mesic Oak; 2) Dry Xeric Oak; 3) Xeric Pine Pine-Oak; and Dry to Dry-Mesic Oak. For each OGCT all acres within the alternative were stratified into one of three categories (high, medium and low) for the level of prescribed fire that could be applied according to individual management prescriptions. Each acreage figure was then multiplied by the Mean Fire Return Interval expressed as a percentage and the high, medium and low estimates were then totaled for each alternative. Alternative B would be the largest prescribed burn program since it is the restoration alternative and biologically driven. Alternative E would generate the smallest prescribed burn program as it has a recreation emphasis designed to attract a variety of users and scenic integrity and visual objectives are paramount in this alternative.

Wildland Fire Use is being able to utilize lightning ignitions, both in and outside of wilderness, by analyzing various parameters such as weather, fuel conditions and expected fire behavior to determine if the lightning fire is within prescription parameters so the fire could be purposefully used to meet prescribe fire management objectives.

Management ignited prescribed fires in wilderness may only be ignited for threatened and endangered species and to reduce unnatural buildups of fuel only if necessary to meet at least one of the wilderness fire management objectives set forth in FSM 2324.21:

1. Permit fire to play, as nearly as possible, their natural ecological role within wilderness; or,

2. Reduce, to an acceptable level, the risks and consequences of wildland fire within wilderness or escaping from wilderness; and

3. If all of the following conditions are met:

    a. The use of prescribed fire or other fuel treatment measures outside of wilderness is not sufficient to achieve fire management objectives within wilderness;

    b. An interdisciplinary team of resource specialists has evaluated and recommended the proposed use of prescribed fire;

    c. The interested public has been involved appropriately in the decision; and,

    d. Lightning caused fires cannot be allowed to burn because they will pose serious threats to life and/or property within wilderness or to life, property, or natural resources outside of wilderness.

Controversy surrounds the use of prescribed burning to maintain pastureland and the balds on the Mount Rogers NRA. Prescribed burning can be used to enhance forage for the wild ponies that reside in the area and to maintain the open, scenic vistas for which the majority of the public chooses to recreate in the area. Critics contend that prescribed burning is maintaining an artificial ecosystem that would convert to the climax spruce-fir habitat that would ultimately have few openings remaining with fire exclusion. The main opposition to prescribe burning in the balds is due to the northern flying squirrel, which is a federally listed species (endangered) that requires the spruce-fir habitat and northern hardwoods.

Prescribed fire can have short-term negative effects on air quality. These effects may be mitigated by burning at certain times of the year, at certain fuel moisture thresholds, and under meteorological conditions that promote smoke dispersion. This information is provided in the burn plan that is prepared for each prescribed fire. A smoke management plan is required for each burn plan. More detail on smoke and air quality is provided in the Air Resource section of Chapter 3 of the EIS.

Fuels management considers both the dead and live fuel components within the fuel complex. These components vary widely across the forest according to ecosystems, insect and disease outbreaks, moisture or drought conditions, and the natural processes that occur without active vegetative management.

The dead fuel components are snags, dead pine needles and leaf litter, dead trees on the forest floor, and shrubs, forbs and graminoids that have a fuel moisture low enough to be consumed in the flaming front of a fire. They comprise the available fuels and these values vary seasonally. Snags are becoming more of a hazard on the Jefferson National Forest with the increasing incidence of gypsy moth, southern pine beetle and oak decline. Snags create a significant safety hazard during wildland fire suppression.

OAK DECLINE

Oak decline is a disease complex that involves environmental and biological stresses, resulting in subsequent attack by secondary pests (Oak et al., 1988; Oak et al., 1991; Leininger and McCasland, 1997). Oak is the major component of dominant tree species on both Forests in Virginia, with oak stands comprising roughly 85% of forest stands. Oak stands on the National Forests are particularly predisposed to oak decline, due in large part to the increasing stand age. Longer rotations will no doubt result in greater mortality. Other factors contributing to oak decline include xeric landforms and associated low site indices. Species composition will also affect tree mortality, with the oak-hickory stands showing the greatest incidence of mortality. Approximately 30% of oak forests in the northern mountainous Virginia area (roughly north of Roanoke) had oak decline symptoms, while the southern mountainous Virginia area (south of Roanoke) had a 9% incidence. Oak decline can adversely affect the quantity and quality of acorns. Coincident occurrence of other stressors, such as drought or gypsy moth defoliation, will contribute to accelerated mortality rates.

GYPSY MOTH

The first outbreak of gypsy moth defoliation in Virginia occurred in 1984. The Lee District on the George Washington National Forest experienced its first major defoliation in 1985, with ensuing mortality in 1987. Drought years in 1987, 1988, and 1991 contributed to subsequent mortality. The major front of initial defoliation marched southward to the Staunton area in 1999, when the population of gypsy moth experienced a crash. Discrete patches of infestation have occurred south of the major line of defoliation, with occurrence in the Peters Mountain Area near Goldbond on the Jefferson National Forest and other areas on private land in Pulaski, Wythe, Bland, and Grayson counties. Multiple defoliations behind the initial wave added to ensuing mortality. On the Lee District, sampled stand conditions without defoliation had an average of 9% stem mortality, with much higher rates for oak species (Tigner, 1992). The majority of mortality following the first defoliation was composed of oak species. Total tree mortality was generally around 30%. Although oak species are still a component of regeneration, it is less common. Much of the mortality occurred on poor sites with limited salvage opportunity. Lee District personnel have associated heavy mortality with drought and where stands had been stressed with recent partial cutting or wildland fire. Snags have been noted to fall more in mesic areas, but less so on more xeric sites. They have also noted that with approximately 10 years since mortality, the chestnut oak stems have a punky outer shell that is receptive to firebrands, as opposed to scarlet oaks. The standing snags have lost much of the crown branchwood, up to approximately 3" in diameter. Those branches have resulted in a fuel bed at the forest floor that heightens fuel depth to 3 feet. Snag to snag ignition has occurred at lower fuel moistures, complicating line-holding capabilities.

A lower incidence of oak decline on the southern districts of the Jefferson National Forest may result in lower amounts of mortality due to gypsy moth defoliation, though weather and other factors may change that possibility.

SOUTHERN PINE BEETLE

Periodic outbreaks of southern pine beetle have created snags in stands of pitch pine and table mountain pine on the Forests in Virginia. Typically located on xeric, low site index soils, these stands have little potential for salvage. With fire seclusion, poor regeneration of these stands is resulting in diminished pine communities. The southern pine beetle attacks result in greater mortality with decadent, older stands. These stands are often associated with pyrophitic *Ericaceous* species. The resulting fire behavior under dry conditions can be extreme.

Besides providing firebrand receptors and sources, snags create safety problems for fire fighters. Snags may fall with little or no warning. Nationally, falling snags and green trees have killed 19 people, 15 of those since 1985. As the time since mortality of snags increases, so does the possibility of the snag falling. Snags are also less predictable when felling, due to decay and breakout of branches. Fallen snags will slow line building rates for fire control.

Snags are an important habitat site for many birds and mammal species. Snags are important to bark-gleaning insectivorous birds and cavity nesters (Stribling, 1990).

Numbers of birds and species richness of birds were found to increase with snag retention.

In prescribed burns, snags are typically felled near control lines prior to ignition (or raked around to prevent ignition), usually limited to within one chain of those lines, depending on the circumstances. An estimate of 5 – 10% of the burn area would receive some snag treatment. With snag recruitment from the prescribed burn (mortality), the number of snags within these burn areas can increase over the short-term.

Snag density can be measured (Bull et al., 1990) to determine adequacy of the snag component. Besides numbers, snag characteristics are important to wildlife species. On the Blacksburg District, Rosenberg and others (1988) measured 1,118 snags on 135 plots to determine snag characteristics as related to foraging and cavity building. They found cavities in 37 snags (3.4%), with a greater proportion of those cavities in larger diameter snags. Snags greater than 20 cm dbh were preferred for foraging. Snags 3.0 to 9.9 cm dbh comprised 54.2% of the total number of snags and accounted for 34.1% of all snags with evidence of foraging. They also found no decline in snag densities with stand age; densities of snags >10 cm dbh were 62.2/ha, 69.3/ha, and 63.6/ha in stands aged 60-70 years, 80-99 years, and 100+ years respectively.

Fragmentation and decay rates of snags are important to both fuels and wildlife managers. Those rates may differ with the mode of recruitment. In California, Morrison and Raphael (1993) found that snags created by fire fell quicker than snags in unburned areas and Labosky and others (1990) found that girdled control trees decayed more rapidly than gypsy moth-killed trees. Hardwood snag fragmentation in a pine-oak forest in southeastern Arkansas was studied to determine fragmentation rates for hardwood snags 2 to 6 years after stem injection with herbicides (Cain, 1996). He found that within three years of injection with herbicide, 57% of snag boles had broken below crown height. The number of cavities increased with time since injection, and at six years since injection, 44% of residual snags had evidence of wildlife cavities. Less than 50% of hardwood snags <25 cm dbh were still standing five years after injection. As expected, the rate for fragmentation was greatest for the smaller diameter snags and lowest for the larger snags. His data suggested that snag recruitment would be needed at intervals of ten years on that site. In the southern Appalachian Mountains, Harmon (1982) examined the decomposition of snags killed by fire for ten species. His study indicates that there are considerable differences between species within a single climatic zone. Standing dead trees 5 to 15 cm dbh were sampled at intervals up to 12 years after the fire.

From these findings, chestnut oak and blackgum had relatively higher rates of decay compared to Virginia pine and eastern hemlock, which had slower rates of decay. In general, the conifers had slower rates of decay than the hardwoods, though dogwood and sourwood also appeared to decay very slowly.

Pierce and Bivens (unpublished data, 1985) developed guidelines for determining the time of mortality for standing dead oak trees. They state that "trees dead one year or less will only have some leaves missing. The many fine twigs remain for about a year and then start to trickle off. Bark is still tight. A tree dead two years will have less numerous, blunter twigs as the very fine ones are gone by this time. Bark starts to loosen. Sapwood just inside the cambium will soften and start to deteriorate. A tree dead three years will have stubbly limbs as the next smaller twigs or limbs trickle off. Bark is loose and sapwood becomes mushy. A tree dead four years or more may have stubs instead of limbs. The bark may be gone or patchy and the sap will be sloughing off.

> "Whole crown should be studied since some trees die a portion at a time over more than one year. The last limbs to die would be used to determine

mortality age.

> "Oak on dry sites deteriorates more slowly than oaks on moist sites. Hickory sap deteriorates faster than oak. Hickory twigs cling longer than oak. Softer woods such as yellow-poplar and buckeye deteriorate much faster than oak."

The stage of snag decay will influence its ability to be both a source of fire brands and a receptor of brands. This can vary within species of the same genus with those species exhibiting a punky exterior being likely receptors of spotting, and those trees with a slick or "case hardened" exterior less likely receptors. Loose hanging bark will also provide likely locations for ignitions. Upper limbs may be punky, while the remaining stem is sound. Spotting from snag to snag has been observed, a troublesome circumstance for fireline control.

The live components of the fuel complex are any living vegetative material that have a low enough fuel moisture content to be consumed in the flaming front of a fire though from a fuels management standpoint we are mostly concerned with the diploxylon pines (pitch and table mountain), mountain-laurel, the *Ericaceous* species, huckleberry and the wilted hardwoods (i.e. when the hardwoods are stressed right before leaf fall or during drought conditions).

The dramatic reduction in fire occurrence, since organized suppression began, has resulted in diminished yellow pine communities, notably pitch pine and table mountain pine. Both species require open, exposed sites for germination, are drought tolerant, shade intolerant, and have thick, insulating bark. Table mountain pine cones exhibit cone serotiny, requiring moderate heat for seed dispersal. Pitch pine can exhibit degrees of serotiny in part of its range. Lack of regeneration and the inability to compete with established hardwoods has led to measurably smaller associated communities (Gibson and Hamrick, 1991; Williams, 1991; Groeschl et al., 1992; Sutherland et al., 1993; Waterman et al., 1995; Turrill, 1998; Williams, 1998; Waldrop et al., 2000).

As pines lose vigor and become susceptible to periodic southern pine beetle attacks or some other malady, their range grows smaller. When burned, the declining pine stands, often associated in a fuel complex with mountain-laurel, can result in a fire intensity that provides the necessary conditions for regeneration of those stands.

These pine stands are typically on poorer, drier sites of timber productivity where soils are steep and thin. The timber itself is poor quality, with minimum marketing potential. Maintaining the diversity that these communities contribute to ecosystem flexibility and health should be a primary goal of forest stewards.

Mountain-laurel is a highly flammable evergreen shrub at certain lower fuel moistures that typically survives fire by sprouting from the root crown or rhizomes after aboveground portions are killed (Niering, 1981; Romancier, 1971). A light to moderate severity fire typically top-kills mountain-laurel while severe fires may completely kill the shrub (Niering, 1981; Thackston et al., 1982). While mountain-laurel foliage is highly flammable at times from a fuels management standpoint; it is also a winter browse species for white-tailed deer.

Both the hillside blueberry and the low sweet blueberry are important wildlife shrubs. Various birds and mammals eat the berries, flower buds and stems at various times of the year (Carlile et al., 1978; Martin et al., 1951; Van Dersal, 1938; Vander Kloet and Austin-Smith, 1986; and Vander Kloet, 1988). Both species are important recolonizers of disturbed sites and are well adapted to fire (Brayton and Woodwell, 1966; Bourgeron et al., 1988; Stocks and Alexander, 1980). They readily regenerate from rhizomes, root crowns, or surviving portions of aerial stems. Fire intensity and severity, season of burn, community type, and soil are important factors influencing postfire response. In general, low sweet blueberry is most reduced by summer fires (Eaton and White, 1960). Burning too frequently may be detrimental to blueberry yield (Black, 1963).

Black huckleberry provides food, shelter, and cover for various wildlife species ranging from game birds, song birds, and black bear, to white-tailed deer. Black huckleberry is fire tolerant and its aboveground parts are destroyed by most fires, but dormant rhizome buds usually survive and sprout (Matlack et al., 1993; Reiners, 1965). Low-severity fire encourages prolific vegetative reproduction of black huckleberry; however, severe fire that burns the humus layer, where many of the rhizomes are, can reduce or eliminate it from a site (Martin, 1956; Matlack et al., 1993). Too frequent fire in black huckleberry usually results in a reduction in its coverage probably because of inadequate time between fires to replenish root resources (Buell and Cantlon, 1953).

Direct and Indirect Effects

Fire hazard can be related to stand age, stand structure, stand composition, and stand density. Fire hazards are greatest in stands where an accumulation of ground fuels and vertical ladder fuels have occurred. Table 3-117 displays the successional stages for forested lands on the Jefferson National Forest. Approximately 73% of the forest is aged 70 and older.

Table 3-117. Successional Stages of the Jefferson National Forest

Successional Stage	Years	Percent of Forested Land
Early Successional	0 - 10	1
Saplings/Pole	11 - 40	9
Mid Successional	41 - 80	41
Late Successional	81 - 99	32
Old Growth	100 +	17

High resource value areas on the forest to be protected include urban interface areas, unique habitats or features, municipal watersheds, sawtimber stands, electronic sites, utility transmission corridors, and scenic recreational corridors as a few examples.

From an effects perspective, wildland fires and prescribed fire should be evaluated separately. Recreation based alternatives would be expected to increase human-caused wildland fire occurrence while all other alternatives would be expected to be roughly equal.

With 81% of our fires being human-caused, recreation impacts are a very important aspect. Alternative E focuses on attracting a variety of recreational users and with increasing recreational pressure it would appear that fire occurrence would also increase. Alternative A with its focus on economic growth would indicate the next largest increase in human-caused fire occurrence followed by Alternatives I and F. Alternatives D and G, which are non-motorized oriented, would have the least effect on human-caused fire occurrence due to the public's access being more restricted.

The fuel loading situation on the Jefferson National Forest has been exacerbated due to ice storms that have occurred over the past twenty years and insect and disease outbreaks during the past few years. Alternative B, the restoration alternative, would have the greatest effect of all the fuels treatment alternatives identified with a proposed maximum treatment target of 19,340 acres per year. Alternatives A, D, G, and I ranged from 14,090 to 15,720 acres and were deemed to be essentially comparable for the purpose of this analysis for their effects. Alternative E, the recreation alternative, would be the next to last desirable option in terms of reducing hazardous fuel accumulations with a proposed maximum treatment target of 9,400 acres. Alternative F, the current alternative, would be the least desirable fuels treatment alternative in terms of reducing hazardous fuels since it would only be treating a maximum of 2,930 acres per year.

The timber management program on the forest is a minor contributor toward hazardous fuel reduction on an annual basis. Those alternatives that harvest a greater number of acres by clearcutting or group selection, in combination with slash disposal, will have the greatest fuel reduction effect since the entire tree is harvested. The shelterwood harvest methods with higher basal area removal factors will leave less residual slash that will need to be treated or it will be hazardous fuel until it decays. The lower the basal area removal factor the more residual slash is left on the harvesting unit. The following is a ranking of the timber alternatives from the most to least effective from a hazardous fuels management perspective: D, A, B, F, I, E and G. Alternative D has the highest combination of harvesting methods utilizing clearcutting and shelterwood with a removal basal area (BA) 50 square feet per acre; Alternative A has the next highest combination of clearcutting, shelterwood with a BA 50, BA 40, BA 20 and group selection; Alternative B was next to A with the exception it had no group selection. From this point, the number of acres harvested by clearcutting or group selection has dropped off dramatically by alternative. Alternatives F and I were approximately half shelterwood harvests with some clearcutting and group selection. Alternative E was over 50% thinning which would leave residual slash on the ground until it decays, 25% in BA 50 shelterwood, 2% in BA 40 shelterwood and the remainder in group selection and clearcuts. Alternative G has the lowest timber harvest output of all the alternatives, 75% of the harvest would be met using shelterwood techniques while the remaining 25% of the harvesting would be accomplished utilizing clearcutting and group selection methods.

The road management program has been declining over the past several years and while any new roads that are built might increase the possibility of human-caused ignitions, they also provide firefighting resources with access as well. There is no one alternative that is superior over the others for road management.

Cumulative Effects

Fuel loadings will continue to increase under all alternatives; however, the alternatives that have a higher prescribe burning program and timber harvest levels, once the slash removal has been completed, should result in smaller increases. Prescribe burn acres were determined for each alternative, it is projected that in ten years 50% of the acres will be in areas that have been previously prescribe burned and in fifty years all of the acres we will be treating will have been previously prescribe burned.

The risk of ignition from lightning fires will remain constant under all alternatives while the risk of human-caused fires is expected to increase in Alternative E due to the increased pressure by recreationists.

In alternatives with less motorized access to the forest, the risk of large fires increases due to the increase in travel time of firefighting resources, as well as, initial reporting time.

Increased development in the urban interface adjacent to the forest boundary will require an increased emphasis be placed on reducing hazardous fuels in those areas.

Priority fire application should involve yellow pine and oak communities. An effective fire

BIOLOGICAL ENVIRONMENT

FUELS MANAGEMENT

SOCIAL AND ECONOMIC DEVELOPMENT

RECREATION

DEVELOPED AND DISPERSED RECREATION

frequency of 15-20 years for those communities is suggested to maintain integrity. Mesic locations included within those burn perimeters will not be affected at the same level of intensity as the drier sites. This will result in a mosaic of effects, with a longer, effective fire frequency for those mesic sites. Special plant communities, for example those including threatened and endangered species or mountain-top balds, may have other fire frequency requirements. Monitoring community trends will remain important to determine direction.

SOCIAL AND ECONOMIC ENVIRONMENT

The social and economic environment is the *people* portion of the environment. It includes natural resource programs and the impacts of these programs on local communities and their economies. This section includes the recreation program, special areas, wilderness and roadless areas, wild and scenic rivers, heritage resources, Mount Rogers National Recreation Area, scenery, timber management, minerals, roads, lands, special uses, and concludes with the social and economic impact analysis that ties it all together.

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National Forests provide over 191 million acres of public land within the United States. National Forests in the Southern Appalachian region contribute approximately 4 million acres to the national total and provide unique settings for a variety of outdoor recreation activities such as primitive and developed camping, hunting, fishing, hiking, backpacking, horseback riding and OHV driving, canoeing/kayaking and whitewater rafting as well as picnicking, sightseeing, nature watching, walking for pleasure and driving for pleasure.

Market Area

Market areas have been established for different national forests to better evaluate public demand for recreation opportunities. Researchers have defined a market area as all counties that fall within a 75-mile straight-line radius from a forest border. Past research has demonstrated that most national forest visits originate from within a 75-mile (1 ½ hour driving time) radius. (*Jefferson National Forest Recreation Realignment Report* Overdevest and Cordell, 2001).

The largest cities within the Jefferson National Forest market area include: Roanoke, VA, Lynchburg, VA; Winston Salem, NC; Greensboro, NC; High Point, NC; and Knoxville, TN.

Opportunities for outdoor recreation are not limited to the national forest within the market area. The Jefferson National Forest provides approximately 723,300 acres of public land in the Southern Appalachian Region of western Virginia. Other public lands such as National Parks, state parks, and state wildlife management areas serve to connect and expand the range of recreation opportunities.

Within the state of Virginia, several State and National Parks are located within a 75-mile radius of the Jefferson National Forest border. National Parks include Shenandoah National Park and the Blue Ridge Parkway. Among the Virginia State Parks are Foster Falls, New River, Hungry Mother, Grayson Highlands, Smith Mountain Lake, Douthat and Claytor Lake State Parks. Several of these facilities provide high levels of development and some accommodate overnight lodging. Smith Mountain Lake and Claytor Lake State

Parks also provide many of the water-based recreation opportunities within the Jefferson National Forest market area. The Appalachian National Scenic Trail provides a unique long distance hiking opportunity across several other Southeastern national forests including the George Washington, Cherokee, Pisgah, Nantahala, and Chattahoochee-Oconee National Forests.

Recreation Demand & Trends

Recreation demand is a complex relationship between people's desires and preferences, availability of time, price, and availability of facilities. The evaluation of current and future demand for recreation on the Jefferson National Forest is based on recent surveys that identify and quantify:

- Estimated number of current recreation visits to the Jefferson National Forest;
- Participation rates for recreation activities within the forest market area;
- Future activity demand based on projected population growth; and
- Activity demand by demographic strata.

The recent National Visitor Use Monitoring (NVUM) effort by the Forest Service has provided baselines for estimating current use of recreation sites on the Jefferson National Forest (Table 3-118). These numbers only account for people visiting developed or dispersed sites for the purpose of engaging in a recreation activity. They do not include the millions of people that simply drive through the national forest.

Table 3-118. Baselines for Recreation Site Use on Jefferson National Forest

Type of Recreation Sites	Current Percentage of Total Estimated Forest Recreation Visits*
Day-Use Developed Sites	35%
Overnight-Use Developed Sites	23%
Wilderness (Dispersed Sites)	3%
General Forest Areas (Dispersed Sites)	39%
Total	100% (1,340,750 estimated visits)

*Refer to process record in Appendix B.

Based on this NVUM data, "developed recreation" areas on the Jefferson National Forest accommodate approximately 58% of the estimated recreation visits. The remaining 42% of recreation visits can be defined as "dispersed recreation" that occurs away from developed sites in general forest areas and designated Wilderness.

During a typical forest visit, people within the defined market area engage in a variety of recreation activities. Table 3-119 lists the most popular activities and shows estimated trends in demand for those activities over the next five decades on the Jefferson National Forest. Census information has been applied to the current number of people participating in the various activities to identify trends in future public demand. The activities are ranked in order from highest to lowest participation rates based on the National Survey on Recreation and the Environment (NRSE), an on-going national telephone survey sponsored by the US Forest Service. These numbers reflect participation in an activity within the defined market area and not necessarily on the Jefferson National Forest.

Table 3-119. Number of People (in millions) over 16 years old Participating in Recreation Activities in Jefferson NF Market Area and Percentage Increase over next 50 years (***Jefferson National Forest Recreation Realignment Report*** Overdevest and Cordell, 2001 and Census Bureau, population projections)

Recreation Activity	Participation Rate[1]	No. of People	Projected Increase[2]				
	2001	2000	2010	2020	2030	2040	2050
View/photograph nature or scenery	62.70%	3.57	15% 4.11	31% 4.68	48% 5.28	66% 5.93	86% 6.64
Picnicking	60.10%	3.42	11% 5.91	23% 6.54	37% 7.29	53% 8.14	71% 9.1
Driving for pleas-ure	57.90%	3.3	15% 3.8	31% 4.32	48% 4.88	66% 5.48	86% 6.14
View wildlife	49.00%	2.79	15% 3.21	31% 3.65	48% 4.13	66% 4.63	86% 5.19
View/photo wild-flowers, trees	46.60%	2.65	15% 3.048	31% 3.472	48% 3.922	66% 4.399	86% 4.929
Visit historic site	43.80%	2.49	22% 3.04	47% 3.66	77% 4.41	113% 5.3	155% 6.35
Swimming in streams, lakes	39.40%	2.24	6% 2.37	13% 2.53	20% 2.69	29% 2.89	41% 3.16
Visit wilderness	36.60%	2.08	25% 2.6	57% 3.27	96% 4.08	108% 4.33	171% 5.64
Gather berries, mushrooms, etc.	31.00%	2.02	15% 2.32	31% 2.65	48% 2.99	66% 3.35	86% 3.76
View birds	34.40%	1.96	15% 2.25	31% 2.57	48% 2.9	66% 3.25	86% 3.65
Day hiking	32.50%	1.85	19% 2.2	38% 2.55	59% 2.94	78% 3.29	94% 3.59
Warm water fishing	31.30%	1.78	9% 1.94	17% 2.08	24% 2.21	26% 2.24	26% 2.24
Visit waterside, beach	26.80%	1.53	10% 1.68	22% 1.87	34% 2.05	48% 2.26	61% 2.46
Drive off-road	25.40%	1.45	5% 1.52	10% 1.6	16% 1.68	23% 1.78	34% 1.94
Motor boating	23.50%	1.34	1% 1.35	3% 1.38	6% 1.42	11% 1.49	17% 1.57
Developed Camp-ing	22.60%	1.29	27% 1.64	60% 2.06	98% 2.55	144% 3.15	201% 3.88
View/photograph fish	21.90%	1.25	15% 1.44	31% 1.64	48% 1.85	66% 2.08	86% 2.33
Mountain biking	19.80%	1.13	12% 1.27	26% 1.42	42% 1.6	61% 1.82	83% 2.07

[1]Participation rates based on *Jefferson National Forest Recreation Realignment Report,* Overdevest and Cordell, 2001.

[2]Projections based on *Outdoor Recreation in American Life, A National Assessment of Demand and Supply Trends,* H. Ken Cordell, Principal Investigator, 1999 with the projections converted to a base year of 2000 instead of original base year of 1995.

Table 3-119. Cont'd. Number of People (in millions) over 16 years old Participating in Recreation Activities in Jefferson NF Market Area and Percentage Increase over next 50 years (***Jefferson National Forest Recreation Realignment Report*** Overdevest and Cordell, 2001 and Census Bureau, population projections)

Recreation Activity	Participation Rate[1]	No. of People	Projected Increase[2]				
	2001	2000	2010	2020	2030	2040	2050
Coldwater fishing	19.50%	1.11	9% 1.21	17% 1.3	24% 1.38	26% 1.4	26% 1.4
Primitive camping	17.00%	0.97	-2% 0.95	0% 0.97	0% 0.97	5% 1.02	0% 0.97
Big Game Hunting	12.10%	0.69	97% 0.67	93% 0.64	89% 0.61	83% 0.57	76% 0.52
Small-game Hunting	11.20%	0.64	97% 0.62	93% 0.6	89% 0.57	83% 0.53	76% 0.49
Backpacking	10.10%	0.58	23% 0.71	57% 0.91	96% 1.14	108% 1.21	171% 1.57
Horseback riding on trails	8.80%	0.5	9% 0.55	19% 0.6	27% 0.64	30% 0.65	31% 0.66
Rafting	8.00%	0.46	5% 0.48	9% 0.5	16% 0.53	30% 0.6	51% 0.69
Canoeing	7.40%	0.42	5% 0.44	9% 0.46	16% 0.49	30% 0.55	31% 0.55
Water Skiing	7.20%	0.41	1% 0.41	3% 0.42	6% 0.43	11% 0.46	17% 0.48
Kayaking	2.00%	0.11	5% 0.12	9% 0.12	16% 0.13	30% 0.14	31% 0.14
Migratory bird hunting	1.20%	0.07	97% 0.07	93% 0.07	89% 0.06	83% 0.06	76% 0.05

Demographic information collected within the market area also revealed trends affecting recreation demand. As a large segment of the American population ages, demand is growing for less physically challenging activities such as viewing and photographing wildlife and driving for pleasure. The desire for easier access to facilities and forest settings is increasing as the physical abilities of the aging population decrease.

Household sizes of two persons, one person and four persons are becoming more typical. Smaller families, couples and individuals seem to enjoy dispersed recreation activities such as wildlife viewing, bird watching, photographing wildflowers, big game hunting, day hiking, and mountain biking.

As population in the market area continues to grow and be developed, public lands such as Jefferson NF will increasingly be seen as a place of relaxation, a quiet retreat from the built community. As forest recreation demands grow, recreation activities are likely to conflict more with each other especially on trails, in backcountry, at developed sites, on lakes, streams, whitewater, and on roads and their nearby environs (Cordell, 2001).

Recreation Supply

For planning purposes, recreation supply is defined as the opportunity to participate in a desired recreation activity in a preferred setting to realize desired and expected experiences. Recreationists choose a setting and activity to create a desired experience. Three components of supply are settings, activities and facilities (SAA, p.140). The US Forest Service manages a variety of settings and facilities.

The Recreation Opportunity Spectrum (ROS) is a planning tool used to identify and evaluate the supply of recreation settings on national forests. Refer to the Glossary of the Forest Plan and Appendix I of the Final Environmental Impact Statement for complete definitions of each ROS class. Four ROS classes are currently inventoried on the Jefferson National Forest as shown in Table 3-120. These settings include Semi-Primitive Non-Motorized (SPNM), Semi-Primitive Motorized (SPM), Roaded Natural (RN), and Rural (R).

Table 3-120. Distributions of ROS Classes on the Jefferson National Forest

Recreation Opportunity Spectrum (ROS) Class	Percentage of National Forest	Current Forest Plan ROS Inventory Acres
Semi-Primitive Non-Motorized (SPNM)	12%	89,700
Semi-Primitive Motorized (SPM)	10%	72,500
Semi-Primitive 2 (SP2)	0%	0
Roaded Natural (RN)	77%	556,470
Rural (R)	<1%	4,630
Total	100%	723,300

Wildernesses on the forest range in size from 2,344 to 11,113 acres. They contain no open roads. With few exceptions, the Wilderness Act prohibits the use of mechanized equipment and motorized transport. Groups of visitors are often limited to a specific size to retain a sense of isolation and solitude.

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 ½ mile to 3 miles from any roads open to motorized use. These settings accommodate dispersed, non-motorized recreation such as hiking, biking, hunting and horseback riding.

Semi-Primitive Motorized (SPM) areas are at least 2,500 acres in size and at least ½ mile from better than primitive roads. These areas may be within ½ mile from primitive roads or trails that allow motorized use.

Roaded Natural (RN) settings are located within ½ mile of open roads and usually provide higher levels of development such as campgrounds, picnic areas and river access points.

Rural (R) settings represent the most developed sites and modified natural settings on the forest, such as the larger recreation complexes. The majority of the rural settings are provided on private land with the national forest serving as a mountainous backdrop for rural development and agriculture in the valleys.

Semi-Primitive 2 (SP2) is a sub classification of Semi-Primitive used only in Alternatives E, G and I. It is a new classification derived during the current forest planning process and, as such, is not included in the current ROS inventory figures below. It includes areas on the Jefferson National Forest that prohibit permanent road construction and thereby buffers SPNM and SPM areas. It was mapped using GIS to buffer these semi-primitive areas by ½ mile or up to primary/secondary roads needed for recreation, rural access, or a sustainable flow of goods and services. All National Forest System (NFS) lands that were not mapped as semi-primitive within inventoried roadless area boundaries were also mapped as SP2.

Primitive (P) is the most remote, undeveloped recreation setting. These settings are generally located at least three miles from any open road and 5,000 acres in size or larger and are usually limited to designated wildernesses. The Jefferson National forest has 11 designated wildernesses but none meet the 5000-acre core area criteria for the Primitive setting. Most of the wilderness acres are classified as Semi-Primitive Non-Motorized. All wildernesses are managed in a manner consistent with the Primitive setting.

The Southern Appalachian Assessment Social, Cultural, Economic Technical Report (SAA) states that in the Southern Appalachian region approximately 45% of region is in Rural Setting, 24% in Roaded Natural Setting, 18% in Urban, Suburban, or Transitional Setting, 8% is considered Primitive or Semi-Primitive Setting. This indicates that Primitive and Semi-Primitive settings are in short supply.

Developed Recreation

Recreation sites are developed within different outdoor settings to facilitate desired recreational use. These facilities include campgrounds, picnic areas, shooting ranges, swimming beaches, visitor centers and historic sites. “Developed recreation” is the term used to describe these types of facilities.

Developed recreation sites provide different levels of user comfort and convenience based on the assigned ROS setting. 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. Different levels of development may be present within large campgrounds.

Level 2 sites are designed primarily for the protection of the site rather than for the comfort of users. Interior Picnic Area is an example of a Level 2 development site with picnic tables and fire rings being the only amenities.

Level 3 sites such as The Pines Campground provide a comparable amount of development for site protection and user comfort. These sites typically include vault toilets, designated campsites or picnic sites and a developed water source.

Beartree and Stony Fork Recreation Areas are examples of Level 4 campgrounds offering more user conveniences such as paved campsites, flush toilets and some combination of bathhouses and/or options for electric or water hookups.

The Grindstone Recreation Area on the Mount Rogers National Recreation Area is the only Level 5 developed site on the Jefferson National Forest. It offers flush toilets, bathhouses with warm showers, and electric and water hookups. These areas also typically have amphitheaters, playgrounds, or other amenities.

The Forest Service defines the capacity of developed recreation sites in terms of “people at one time” a site can support (PAOTs). Currently, there are over 115 developed sites managed by the Jefferson National Forest to accommodate different recreation activities. Table 3-121 and Table 3-122 illustrate the different types of facilities provided across the forest and their current capacity in PAOTs.

A few low use Level 2 campgrounds and day-use areas will likely be closed over time due to high maintenance costs. Two horse camps currently located in or near riparian zones will be relocated to reverse riparian resource degradation and alleviate sanitation concerns.

Table 3-121. Current Capacities of Day-Use Developed Areas on Jefferson National Forest (Persons-at-one-time, PAOT)

Type of Day Use Developed Areas	Total Number of Areas	Total Capacity (PAOT)
Picnic Areas	30	2,872
Beaches & Swimming Areas	6	630
Shooting Ranges	3	55
Parking areas, overlooks, historical & minor interpretive sites	23	1,075
Visitor Centers	4	142
Cabins	3	23
Total Day-Use Capacity	69	4,797

Table 3-122. Current Capacities of Overnight-Use Developed Sites on Jefferson National Forest (Persons-at-one-time, PAOT)

Level of Campground	Total Number of Campgrounds	Total Capacity (PAOTs)
Level 2 Campgrounds	7	265
Level 3 Campgrounds	16	1,095
Level 4 Campgrounds	6	1,155
Level 5 Campgrounds	1	540
Total Overnight Capacity	30	3,055

The public demand for campsites with a development level of 4 or 5 currently exceeds supply, especially on weekends. Many visitors desire sites with water and electrical hook-ups and sites that are more accessible. As older campgrounds are reconstructed, utility hookups and accessible sites are being provided where feasible.

Dispersed Recreation

Dispersed recreation is defined as those activities that occur outside of developed recreation sites such as boating, fishing, hunting, hiking and biking. There are 16 developed recreation sites (Table 3-123) that facilitate dispersed use of the forest such as trailheads (including parking areas and toilets) and boat ramps.

Table 3-123. Developed Access Points for Dispersed Recreation on Jefferson National Forest (Persons-at-one-time, PAOT)

Type of Developed Site	Total Number of Sites	Total Capacity (PAOT)
Trailheads	8	570
River Access Points	0	0
Lake Boat Ramps	4	285
Fishing Sites	4	89
Total	16	944

Larger streams passing through the forest such as the James River, New River, Whitetop Laurel, and Craig Creek provide fishing, canoeing and, in some cases, a minor amount of kayaking and rafting. Other streams providing scenic and recreational value include Little Stony Creek (Giles County), Little Stony Creek (Scott County), Dismal Creek, Stony Creek, Guest River, North Creek, and Jennings Creek. North Fork of Pound Reservoir and Lake Keokee are impoundments within the forest that provide flat-water bodies large enough to support motor boating and other water-related recreation activities. However, a larger share of these opportunities is supported at Smith Mountain Lake and Claytor Lake State Parks.

Over 1,100 miles of non-motorized trails traverse the forest including the Appalachian National Scenic Trail (AT) and seven National Recreation Trails (Table 3-124). The AT traverses about 317 miles on the Jefferson National Forest and remains the preeminent long distance hiking trail in the nation. Other popular trails include the Virginia Creeper, Cascades and Apple Orchard Falls, all of which are National Recreation Trails. Hiking and backpacking remain popular. Both mountain biking and horseback riding continue to increase in popularity across the forest. With the exception of the AT, the majority of the non-motorized trails on the forest are multi-purpose, allowing hiking, mountain biking, and horseback riding. Refer to the Special Areas section for more discussion of the Appalachian National Scenic Trail.

Table 3-124. Miles of Non-Motorized Trails on Jefferson National Forest

Type(s) of Non-Motorized Use Allowed	Existing Miles of Designated Trails
Hike only	468
Hike and Bike only	41
Hike and Horse only	111
Hike, Bike and Horse only	505
Total	1,125

Motorized trails appropriate for Off-Highway Vehicles (OHVs) are limited to about 16 miles of designated motorcycle/ATV trails within the Patterson Mountain ORV Area on the New Castle Ranger District. An additional 46 miles of trail is open to licensed motorcycles on the Mount Rogers NRA. Open roads with low maintenance levels have traditionally provided some opportunities for street legal 4WD vehicles and motorcycles to access remote, scenic settings on the forest (Table 3-125).

Hunting and fishing, though no longer among the most popular, are important traditional recreations activities on the forest. Table 3-126 reflects a quantified estimate of habitats emphasizing or favoring fishing (both warm and cold water) and hunting.

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 overtime (Cordell, 2001).

Patterson Mountain ORV area, containing 16 miles of motorized trail, is the only area on the forest allowing unlicensed ATV's and motorcycles. An area was analyzed on the New River Valley Ranger District in 1998 but was not established due primarily to conflicts with

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adjacent private landowners. Demand for ATV use exceeds supply and illegal use is increasing in a number of areas, including into wilderness.

Table 3-125. Miles of Motorized Multiple Use Trails on Jefferson National Forest

Type(s) of Motorized Use Allowed	Existing Miles of Designated Trails
Motorcycle only (licensed)	46
ATV only	0
Motorcycle and ATV only	16
Roads providing a degree of challenge for street legal 4WD vehicles and motor-cycles	38
Total	100

*Street Legal Vehicle trails are defined as National Forest System Roads open to the public for at least a part of each year with management objectives of Traffic Surface Level (TSL) D and Maintenance Level (ML) 2.

Table 3-126. Acres of Current Habitat Emphasis Areas

Type of Fish & Wildlife Habitat Emphasis	Unit of Measure
Cold water streams (wild trout)	300 miles
Cool/warm water streams	228 Miles (approx. 20 miles stocked)
Reservoirs	348 Acres (approx. 300 acres stocked)
Early Successional Habitats (8B, 8E1)	35,700
Small and Big Game Habitats (7E2, 8A1, 9H and 10B)	262,600 acres

Non-motorized use off of designated trails (mountain biking, horseback riding and hiking) is increasing and in some areas is establishing patterns of use. This unplanned, and sometimes illegal use degrades the quality of the environment especially riparian resources and the visitor experience. An increase in visitor controls and regulations may be necessary in the future to direct visitor use, prevent further resource degradation and avoid the high cost of restoring and rehabilitating damaged landscapes.

Direct and Indirect Effects

Existing recreation demand is expected to grow for a variety of activities including dispersed and developed recreation (See Table 3-119). Existing use will increase as recreation demand and population grows over the next ten years.

Effects to recreation are based on the overall design criteria that alternatives must be implementable according to the existing budgeting process and projected budget trends. General themes were developed for Alternatives A, B, D, E, G and I that emphasize different resource management objectives. Alternative F represents the current management alternative and provides a baseline for evaluating other alternatives. Each alternative theme and its allocation of prescription areas provide the parameters for redefining the current distribution of the Recreation Opportunity Spectrum (ROS) as well as the level of facility development.

National Forest 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. Evaluation of potential recreation effects requires that these elements be considered: activities, setting, and experiences. Estimates of recreation visits can be found in Appendix B.

RECREATION OPPORTUNITY SPECTRUM

General themes were developed for Alternatives A, B, D, E, G and I that emphasize different resource management objectives. Each alternative theme and its allocation of prescription areas provide the parameters for redefining the current distribution of the Recreation Opportunity Spectrum (Alternative F) across the Jefferson National Forest.

Road management direction and the emphasis placed on either dispersed or developed recreational use were major factors in determining the effects of each alternative to recreation.

Table 3-127 displays estimated distributions of acres of ROS classes by alternative. The increases in SPNM from current direction (Alternative F) in all alternatives are primarily based on the allocation of management prescriptions that emphasize SPNM, such as 1B, 12A, 12B and 12C.

Table 3-127. Estimated Distributions of ROS Classes by Alternative (Acres)

ROS Class	Alternative						
	A	B	D	E	F	G	I
SPNM **	117,250	117,250	117,250	117,250	89,700	117,250	117,250
SPM	20,690	20,690	20,690	20,690	72,500	20,690	20,690
SP2	0	0	0	98,800	0	98,800	98,800
RN	580,730	580,730	580,730	481,930	556,470	481,930	481,930
R	4,630	4,630	4,630	4,630	4,630	4,630	4,630
Total	723,300	723,300	723,300	723,300	723,300	723,300	723,300

* Baseline = Alternative F, current direction

** Includes Management Rx 1A and 1B acres.

Estimated increases in Semi Primitive 2 (SP2) in Alternative E, G, and I reflect a shift of acres from both SPM and RN. The shift from RN takes place by employing SP2 as a buffer to protect against further erosion of settings due to the potential for permanent road construction. The shift from SPM to SP2 reflects loss in SPM acres from the current plan inventory primarily due to recent development of large adjacent private land tracts. SP2 is similar in its setting to RN.

Alternatives A, B, and D do not employ SP2. The increase in RN at the expense of SPM is due primarily to private land effects.

Although there are significant thematic differences among the alternatives, the amount and permanence of roads is considered the primary driver in predicting changes in ROS settings.

Alternatives E, G, and I secure the greatest combined Semi-Primitive acreage. Changes in settings will be positive for those visitors seeking a more remote, backcountry experience and less positive for those seeking a more developed setting and motorized access.

Alternative E emphasizes the provision of high quality scenery and diverse recreation settings throughout the forest including a greater increase in Primitive. Existing and new facilities support a wide range of dispersed and developed recreation activities.

Alternative A is primarily focused on recreation development linked to commercial opportunities. The majority of facility improvements would accommodate popular activities that generate money for local economies. This strategy also includes increasing use of outfitter guides in semi-primitive settings.

Alternative I is similar to Alternative E and allows for an increase in both Semi-Primitive Non-Motorized and Semi-Primitive 2 settings. This would protect the SPNM settings from moving to RN through adjacent road construction. Facility improvements support developed and dispersed recreation, but there is an emphasis on maintaining existing facilities to visitor expectations and connecting existing trails to create more loop opportunities.

Alternatives B and D place the least emphasis on recreation as compared to other alternatives. The current level of recreation facilities and infrastructure would remain close to the current level, or decrease. Scenic integrity of dispersed settings would decline over time. There could be some erosion of SPNM over time under these alternatives.

Alternative G protects the SPNM settings as in Alternatives E and I. Due to its substantial increase in areas recommended for wilderness and overall theme emphasizing large undeveloped blocks of land, it would favor primitive and remote experiences to the highest degree of the alternatives.

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Table 3-128 displays estimated increase in capacity of developed recreation areas by alternative. Capacity is displayed in terms of People At One Time (PAOT) as previously defined.

Table 3-128. Estimated Increase in Capacity of Developed Recreation Areas by Alternative (Persons-at-one-time, PAOTs)

Type of Development	Alternative						
	A	B	D	E	F	G	I
Day-Use Areas	Mod	Low	Low	Mod	4,797	Low	Low
Level 2 Campground	Mod	Low	Low	Mod	265	Low	Mod
Level 3 Campground	High	Low	Low	Mod	1,095	Low	Mod
Level 4 Campground	Mod	Low	Low	Mod	1,155	Low	Low
Level 5 Campground	Low	Low	Low	Low	540	Low	Low
Total	Mod	Low	Low	Mod	7,852	Low	Mod

*Baseline = Alternative F, Existing Developed Recreation PAOTs
Low Increase = < 5% increase in existing PAOTs
Moderate Increase = 6-25% increase in existing PAOTs
High Increase = > 26% increase in existing PAOTs
Decrease = any net loss of existing PAOTs

Alternatives A, E and I allow for some expansion and improvement of developed recreation. Each alternative proposes only a moderate increase due the reality of limited fiscal budgets. All three alternatives provide improvements necessary for public health, safety, and accessibility.

Alternative A maximizes development by expanding and upgrading key Level 3 and 4 Campgrounds by adding amenities at campsites such as utility hookups, improving or expanding incorporated day-use facilities and improving accessibility. Several Level 2 and 3 Campgrounds are rehabilitated and redesigned. Horse camps are relocated, upgraded, and expanded. The Glen Alton Tract is developed for day and overnight use with an expected campground development level of at least 3.

Alternative E spreads the moderate increase across most development levels in day-use and overnight-use sites. Redesign and upgrading of Level 3 Campgrounds would be more modest than under Alternative A.

Alternative I is similar to Alternative E but there would be less emphasis on upgrading and expansion to attain higher development levels in campgrounds. Day-use facilities would not be increased or expanded as much as under Alternatives A or E. New day-use and overnight facilities may be constructed at a development level appropriate for the desired ROS setting. However, maintenance and improvements to existing sites will be a higher priority than constructing new facilities.

Alternatives B, D, and G provide the least amount of change in developed recreation. The existing capacity and development levels of recreation sites should remain similar to current conditions. Facility maintenance would focus primarily on improvements necessary for public health, safety and accessibility. Popular sites would be overused and crowded at peak times such as holidays and weekends. This may lower visitor satisfaction over time. Improvements would be generally more for site and resource protection than providing visitor comfort and convenience.

DISPERSED RECREATION

Non-Motorized Trails

Table 3-129 shows a comparison of non- motorized trails for each alternative.

Table 3-129. Estimated Change in Non-Motorized Trails by Alternative

Type of Trail	Alternative						
	A	B	D	E	F	G	I
Hike only	Low	Low	Low	Low	468	Low	Low
Hike and Bike only	High	Low	Low	High	41	Low	High
Hike and Horse only	Mod	Low	Low	Mod	111	Low	Mod
Hike, Bike and Horse only	Mod	Low	Low	Mod	505	Low	Mod
Total	Mod	Low	Low	Mod	1,125	Low	Mod

Baseline = Alternative F, Existing Miles of Trail

Low increase = < 5% increase of existing miles of trail

Moderate increase = 6-25% increase of existing miles of trail

High increase = > 50% increase of existing miles of trail

Decrease = any net loss of existing trail

Alternative A proposes the greatest increase in non-motorized trails including single and multiple use trails throughout the forest. It would tend to increase single use trails more than the other alternatives to attract mountain bike and horse users. Emphasis in new construction would be on maximizing connections to local communities, supporting local economies, and/or encouraging commercial ventures.

Alternative E and I propose a similar, moderate amount of increase in non-motorized trails with both providing opportunities for a wide range of dispersed recreation activities. Under Alternative I, in certain problem areas, horse and mountain bike use will be confined to a 300-foot corridor along each side of designated trails and roads to address emerging patterns of user-created trails that cause resource damage and visitor confusion. In both alternatives there is an emphasis on maintaining existing facilities to visitor expectations and connecting existing trails to create more loop opportunities.

Alternatives B, D, and G do not support a net increase in non-motorized trails although there would be some reconstruction and/or relocation. A few trails may be added to the trail system through construction or closure of existing roads but closing trails causing resource problems would offset this increase. Alternatives B and G would restrict all trail uses, except hiking, to existing trails. Alternative G would result in a significant amount of mountain bike use displacement due to the relatively large amount of Recommended Wilderness Study Areas, which would prohibit such use.

Motorized Trails

Table 3-130 and Table 3-131 show comparisons of motorized trails for each alternative. Proposed ATV areas must meet a set of screening criteria for new OHV areas as described in Appendix J of the Forest Plan.

Table 3-130. Potential New Designated ATV Areas by Alternative

Type of Motorized Use	Alternative						
	A	B	D	E	F	G	I
Potential New 7C Designated ATV Areas	2	0	0	1	0	0	1-2
Miles of Trail	60	0	0	30	0	0	30-60

Table 3-131. Estimated Change in Motorized Trails by Alternative

Type(s) of Motorized Use Allowed	Alternative						
	A	B	D	E	F	G	I
Motorcycle only (licensed)	Low	Low	Low	Low	46 mi.	Dec	Low
Motorcycle and ATV only	High	Low	Low	High	16 mi.	Dec	High
7C OHV routes suitable for street legal 4WD vehicles and motorcycles	High	Dec	Mod	Mod	38 mi.	Dec	Mod
Total	High	Dec	Mod	Mod	100 mi.	Dec	Mod

Baseline = Alternative F, Existing Miles of Motorized Trail
Low increase = < 10% increase of existing miles of trail
Moderate increase = 11-50% increase of existing miles of trail
High increase = > 51% increase of existing miles of trail
Decrease = any net loss of existing trail

Alternative A proposes the highest level of motorized trail development. It proposes two potential new ATV areas, which would include a total of about 60 miles of ATV trails. These areas would be allocated from their current management prescription to management prescription 7C (Off-Highway Vehicle Use Areas) upon site-specific analysis assuming certain screening criteria are met. Alternative I proposes 1-2 new areas, totaling 30-60 miles of trail. Alternative E proposes one new area totaling about 30 miles. Alternatives B, D, do not propose new ATV areas. Alternative G would eliminate the existing ATV area. The allocations of ATV trail riding opportunities in Alternative A, E and I would increase noise disturbance in the affected recreation setting and may displace or lessen the recreation experience of others seeking solitude and quiet forest settings.

Opportunities to provide additional quality 4WD routes are limited across the alternatives. Road construction for the purpose of providing high maintenance jeep trails is not feasible, especially for the purpose of creating technically difficult trails. Of the over 500 miles of forest system roads with road management objective Traffic Service Level D, Maintenance Level 2, there are about 38 miles of road currently considered suitable for, or have historical, jeep use (Alternative F). Alternative A would provide the best opportunity to identify and manage additional existing roads for this purpose. Alternatives D, E, and I would recognize a moderate amount of additional mileage. New road construction for purposes of vegetation management or recreation access may help connect existing 4WD roads in some cases. Alternative B would reduce the existing number of identified 4WD roads. In each alternative, the identified roads would become "linear" 7C areas, which would, in effect, retain their "rough" characteristics as well as serve to keep them open at least a portion of the year.

Alternative G would identify no 4WD roads. This would not preclude street legal vehicles from using open roads but the use would not be encouraged and the roads could subsequently be closed to this use.

Opportunities to provide additional licensed motorcycle trails are limited across all alternatives. This has developed as a unique opportunity on the Mount Rogers NRA in which motorcycle riders share the trail with all non-motorized users on specific trails. None of the alternatives would add motorcycle trails. Alternative G would reduce the mileage slightly with the inclusion of the Little Dry Run Addition Roadless Area as a Recommended Wilderness Study Area.

Alternatives that emphasize prescriptions that provide habitat for big and small game will increase opportunities for hunting and wildlife viewing. Table 3-132 displays the allocation of acres to these types of prescriptions by alternative.

Table 3-132. Estimated Total Acres of Big and Small Game Emphasis Areas by Alternative

Type of Game Habitat*	Alternative (thousands of acres)						
	A	B	D	E	F	G	I
General Habitat	248	278	436	73	370	132	254
Early Successional Habitat	28	15	4	13	45	0	47
Total	276	293	440	86	415	132	301

*General big and small game habitat includes Prescriptions 7E2, 8A1, 8C, 9H, 10A-E. Early successional habitat includes Prescription 8B and 8E1.

Changes in the quantity of wild and stocked streams and reservoirs are not displayed because changes were not proposed in any of the alternatives. Therefore, fishing opportunities are very similar across all alternatives. River and lake access will be enhanced somewhat under Alternative A with the expected expansion of stream access.

In terms of general habitat, Alternative D allows for the most active management for big and small game habitat. Effects of this emphasis include increased opportunities for hunting and non-consumptive wildlife viewing on some parts of the forest. Visitor experience is enhanced as chances of encountering big and small game are increased.

Alternative I provides the most early successional habitat to promote grouse populations. Alternative A manages a lesser amount of general and early successional habitat, but promotes seasonal hunting and wildlife viewing opportunities in areas to support local tourism.

Alternatives E and G provide the least amount of opportunities for game species habitat manipulation and improvement. Opportunities to hunt or view wildlife may not be decreased, but chances of encountering game are diminished over time as populations decrease. Access would be most limited under Alternative G due to the greatest increase in Recommended Wilderness Study areas.

Cumulative Effects

Cumulative Effects for all aspects of recreation are summarized at the end of the Recreation Section.

SPECIAL AREAS

The Forest Service is committed to protect and, where appropriate, foster public use and enjoyment of areas with scenic, historical, geological, botanical, zoological, paleontological or other special characteristics, and classify areas that possess unusual recreation and scientific values so that these special values are available for public study, use and enjoyment. Other uses are permitted in these areas to the extent that these uses are in harmony with the designation. Special areas may be designated administratively or may receive designation by law.

This section includes Special Areas, Scenic Areas, Scenic Byways, and the Appalachian National Scenic Trail. Historical, geological, botanical, zoological, paleontological, archeological or other characteristics are described in other sections of the EIS. For example, geologic areas are covered in the Geology section of this EIS.

Special Areas on the Jefferson National Forest are shown in Table 3-133 and described below.

Special Areas

The Special Areas listed in Table 3-133 were identified in the 1985 Jefferson National Forest Plan or in subsequent amendments to that Plan. These areas have been digitized so the acres shown are based on GIS mapping and therefore vary from the 1985 Plan acres. Each of the Special Areas was given specific management direction under MA5 of the 1985 Plan, which served to protect and maintain the unique resources, qualities and characteristics of the area.

Table 3-133. Special Areas, Scenic Byways, and Appalachian Trail on the Jefferson National Forest

SPECIAL AREAS	Acres	Miles	DISTRICT
Mill Creek	2,058		New River Valley
Roaring Branch Gorge	304		Clinch
Guest River Gorge	1,620		Clinch
Hipes Branch	3,508		New Castle
Peters Mountain Bogs	627		New Castle
Whitetop Mountain	3,535		Mount Rogers NRA
Rush Creek	72		Mount Rogers NRA
Whitetop Laurel Gorge	1,199		Mount Rogers NRA
Little Laurel Creek	195		Mount Rogers NRA
Apple Orchard Falls	1,714		Glenwood
Little Wolf Creek	472		New River Valley
SCENIC BYWAYS			
Big Walker		16	New River Valley
Mount Rogers		56	Mount Rogers NRA
APPALACHIAN NATIONAL SCENIC TRAIL		317	Glenwood, New Castle, New River Valley, Mount Rogers NRA
TOTAL	**11,796**	**389**	

MILL CREEK was identified as a Wilderness Study Area in the Wilderness act of 1975. Subsequently, it was not recommended for Wilderness because of permanent man-made developments within the area. This area includes that portion of the original Wilderness Study Area northeast of the AEP powerlines. The area is a perched valley that provides primitive recreation opportunities including hiking, hunting, fishing, primitive camping and outstanding scenic viewing. It includes a three mile section of the AT including Angel's Rest, a prominent vista.

ROARING BRANCH GORGE is one of the finest natural settings in southwest Virginia. The main recreation use of the watershed is hiking the Stone Mountain Trail. The trail starts at the mouth of Roaring Branch and continues to climb to Butte Knob, a spectacular 2900 foot crag that boasts one of southwestern Virginia's best views. The stream has numerous free-fall small cascades, cascades over tilted bedrock troughs, and many small pools flowing through the boulder and cobble-strewn stream channel.

GUEST RIVER GORGE includes a unique section along the Guest River. At the bottom of a steep gorge is approximately 5.7 miles of former railroad grade that provides excellent opportunities for hiking and bike riding. Views along the gorge are excellent.

HIPES BRANCH is a rugged area with steep slopes going up to rocky cliffs on Rich Patch and Pine Mountains. Hipes Branch and Stony Run are native trout streams cascading through the lower elevations. Large hemlocks, birches and rhododendron line these steams. Elevations range from 1500 to 3700 feet. Recreation opportunities include hiking, hunting, fishing, and primitive camping. The rugged terrain and remoteness of the area present good opportunities for solitude and physical challenge.

PETERS MOUNTAIN BOGS is a small area that includes moist sites at the headwaters of several small drainages near the top of Peters Mountain. Part of this area is a true wetland, supporting vegetation that is dependent upon saturated soil for part of its life cycle. This bog is a result of a minor fold in the underlying sandstone bedrock, which became sealed with fine materials. The vegetation is uncommon, with potential for sensitive plants. The perennial water source near the top is important to the area's wildlife, which includes bear, pileated woodpecker, deer, turkey and grouse.

WHITETOP MOUNTAIN, at 5560 feet elevation, is the second highest peak in Virginia. The Whitetop Mountain Special Area, which lies on the north face of the mountain, contains red spruce at its summit with the rest of the area in northern hardwoods, such as northern red oak, beach, and maple. The area contains many significant biological, ecological, recreational, social and economic values.

RUSH CREEK is identified as a "study area" in the 1980 Mount Rogers NRA Plan. It is composed primarily of old growth hemlock. Trails from Sandy Flats to Shaws Gap connect with the Iron Mountain trail to provide loop hikes. The Feather Camp observation site is nearby. The area has recreational, ecological and historical values.

WHITETOP LAUREL GORGE is a steep-walled rocky gorge featuring scoured basins and pools within the stream channel. The gorge parallels U.S. Highway 58 between Konnarock and Damascus. The primary features within this area include: the Virginia Creeper National Recreation Trail; Appalachian National Scenic Trail; Whitetop Laurel Accessible Fishing Trail; Mount Rogers Scenic Byway; Whitetop Laurel Creek, a blue-ribbon trout stream; and Whitetop Laurel Slopes, a 42-acre Special Biological Area supporting a rare community.

LITTLE LAUREL CREEK was identified in the 1980 Mount Rogers NRA Plan as a Nature Study Area composed of old growth stands of northern hardwood and hemlock. The creek supports a longstanding beaver population. Cherry Tree Camp near the eastern end is an historical Native American encampment. The area has ecological, historical and recreational values.

APPLE ORCHARD FALLS is a small area surrounding a 200-foot falls of the main headwater of North Creek. The area features large boulders and overhanging rocks in a lush vegetative setting. The falls are accessed from the Blue Ridge Parkway above and the several trailheads below by the Apple Orchard Falls and Cornelius Creek National Recreation Trails form a 6-mile loop.

LITTLE WOLF CREEK in Bland County provides excellent opportunities for hiking and nature study. The stream environment displays numerous rock formations forming a series of small cascading waterfalls. Sharp cliffs narrow the lower portion of the stream to a gorge. About three miles of the AT pass through the area.

Scenic Byways

Driving for pleasure is always in the top ten of recreational pursuits on National Forests: people enjoy touring the rural communities and National Forests by car. In 2000, 53% of the Southern population participated in this activity. ("Draft, Southern Forest Resource Assessment", Chapter SCIO-6, Table 2, pg. 26.) The Jefferson's two National Forest Scenic Byways were designated in the late 1980's.

THE MOUNT ROGERS SCENIC BYWAY is found in southwest Virginia in the Mount Rogers National Recreation Area. The byway weaves through serene, pastoral valleys dramatically back-dropped by the highest mountains in Virginia. The byway is divided into three parts. Starting from the Forest Service visitor center south of Marion, Virginia, it runs south on Route 16 to Troutdale. The second section is from Troutdale southwest on Virginia Route 603 through the pastoral Fairwood Valley to the intersection with US. Highway 58. The third section of the byway is located on US 58, from Damascus up and over mountains to the east of Volney. Attractions in the area include the Appalachian Trail, Virginia Highlands Horse Trail, Virginia Creeper Trail, Little Wilson Creek Wilderness, Lewis Fork Wilderness, the Beartree Recreation Area, Hurricane Campground, Raccoon Campground, Grayson Highlands State Park, and Whitetop Mountain.

THE BIG WALKER MOUNTAIN SCENIC BYWAY is a paved, 16-mile open loop around and up Big Walker Mountain in southwest Virginia on the New River Valley Ranger District. Beginning in Wytheville, the byway runs northwest on Interstate 77, exiting at Exit 10 onto Virginia Route 717. It travels west on 717 to its junction with U.S. Highway 52 and then follows US 52 back north and east to I-77. It winds through beautiful southern Appalachian hardwood forests offering vistas of pastoral valleys, fall color and diverse wildlife. The area is rich in history with stories of the original settlers to the area and its role in the Civil War. The Appalachian Trail, Mount Rogers National Recreation Area, Wytheville State Fish Hatchery and Rock House Museum in Wytheville are all nearby.

The Appalachian National Scenic Trail

Designated a National Scenic Trail by Congress in 1968, the Appalachian Trail (AT) is a way, continuous from Katadin in Maine to Springer Mountain in Georgia, for travel on foot through the wild, scenic, wooded, pastoral and culturally significant lands of the Appalachian Mountains. The famous AT is a beacon for dispersed recreation on NFS lands in the Southern Appalachians. It is a magnet for day hikers and is preeminent in its long distance backpacking opportunities. The AT in the Jefferson National Forest winds its way over 300 miles on forested mountain ridge tops and rocky streams, through the Mount Rogers high country and into the picturesque southwest Virginia Ridge and Valley Province, moving from wild to pastoral settings. There are 32 shelters for overnight camping and a number of trailheads that provide access from primary road systems. Strong communities of volunteers work with the Forest Service to plan and maintain the AT; this relationship is formalized in the Appalachian Trail Conference (ATC) and its trail clubs.

Additional Wilderness Study Areas

These are relatively small areas with few if any improved roads which were not included in the Roadless Inventory but which are considered for potential recommendation as Wilderness Study Areas (1B). They are shown in Table 3-134 and described below. The evaluations for these areas can be found in the Process Records.

Table 3-134. Additional Wilderness Study Areas

Additional Study Areas	Acres	District
Cave Springs	3,300	Clinch
Helton Creek	313	Mount Rogers NRA
Stone Mountain	103	Mount Rogers NRA
Total	3,716	

CAVE SPRINGS WILDERNESS STUDY AREA is located on Clinch Ranger District, in the northeastern corner of Lee County, Virginia. The area is found within the Keokee U.S.G.S. Quadrangle and is generally bounded by private land on all sides except in the northeast corner. To the north of the area lies the North Fork of the Powell River. A section of a Norfolk and Southern Railroad line intersects the northern edge of the area in several locations. Major vehicular access to the area is limited. State Route 621 to State Route 845 into Cave Springs campground at the southern edge is the only convenient and direct access. State Route 625 approaches the area from the north and ends close to the area boundary at Payne Branch.

HELTON CREEK WILDERNESS STUDY AREA is located on the Mount Rogers National Recreation Area, in Grayson County, Virginia. The area is surrounded by NFS lands. The area is bounded by Lewis Fork Wilderness to the north and east, Helton Creek Spur Trail to the west, and Helton Creek Trail to the south. The area is found within a portion of Virginia U.S.G.S. Whitetop Quadrangle. There is no vehicular access to this area.

STONE MOUNTAIN BRANCH WILDERNESS STUDY AREA is located on the Mount Rogers National Recreation Area. The area is in Grayson County, Virginia. The Forest Service obtained this area in 2002 from the Virginia Department of Conservation and Recreation through an exchange. Prior to 2002, this area was managed as part of Grayson Highlands State Park. The area is surrounded on three sides by NFS lands. One side is adjacent to Grayson Highlands State Park. The area is bounded by Little Wilson Creek Wilderness to the north, south and east. Big Wilson Creek is the western boundary between the study area and Grayson Highlands State Park. The area is found within a portion of U.S.G.S. Virginia Quadrangle Troutdale. There is no vehicular access to this area.

Direct and Indirect Effects

The alternatives allocated each of the special areas to a mix of prescriptions depending upon the theme. The foreground of the two Scenic Byways was protected and given a High Scenery Integrity Objective (SIO) in all alternatives. Likewise, the Appalachian Trail corridor is protected identically in all the alternatives.

The alternatives allocate the 11 existing Special Areas and the three wilderness study areas somewhat differently. Table 3-135 shows the management prescriptions allocated to each area by alternative.

Alternative A

All of the Special Areas would be allocated to management prescriptions retaining the unique resources, qualities and/or characteristics that resulted in their identification in the 1985 Plan. Roaring Branch Gorge, Guest River Gorge, and Whitetop Laurel Gorge are each allocated to Eligible Wild and Scenic River prescriptions (2C1 or 2C3), which will protect their outstandingly remarkable values. Little Wolf Creek, Hipes Branch, and Stone Mountain are Recommended Wilderness Study Areas (1B). Rare communities (9F) would be managed in the Peters Mountain Bogs and Cave Springs areas. Most of the Cave Springs area would be suitable for timber management (7E2 and 8C) under this alternative.

Alternative B

All of the Special Areas would be allocated to management prescriptions retaining their unique resources, qualities and/or characteristics. This alternative emphasizes allocation to old growth and backcountry recreation prescriptions (6A, 6C, and 12B). Guest River Gorge is allocated to the Scenic Area Prescription (4F). Little Wolf Creek, Hipes Branch, and Stone Mountain are Recommended Wilderness Study Areas (1B). Rare communities (9F) would be managed in the Peters Mountain Bogs and Cave Springs areas. Most of the Cave Springs area would be suitable for timber management (8A1, 8A2, and 8C) under this alternative.

Table 3-135. Special Area Management Prescription Allocation (Percent) by Alternative

Special Area / Wilderness Study Area	Management Prescription by Alternative A	B	D	E	F (Acres)	G	I
Mill Creek	4A 16% 12B 84%	4A 16% 12B 84%	4A 16% 12B 84%	4A 16% 4F 84%	2,058	4A 39% 6C 61%	4A 16% 12B 84%
Roaring Branch Gorge	2C1 100%	6A 66% 6C 34%	6A 66% 6C 34%	2C1 100%	304	2C1 100%	2C1 100%
Guest River Gorge	2C3 69% 4F 31%	4F 100%	2C3 69% 4F 31%	2C3 69% 4D 12% 7E2 19%	1,620	2C3 69% 4F 18% 8A2 13%	2C3 81% 4D 19%
Hipes Branch	1B 100%	12B 100%	1B 100%	1B 100%	3,508	1B 100%	4K2 94% 7E2 6%
Peters Mountain Bogs	9F 100%	9F 100%	9F 100%	9F 100%	627	9F 100%	9F 100%
Whitetop Mountain	4A 37% 4F 63%	4B2 38% 9B3 62%	4B2 38% 9B3 62%	4A 37% 4F 63%	3,535	4B2 38% 9B3 62%	4K4 100%
Rush Creek	4F 92% 7B 8%	6A 61% 6C 31% 8A1 8%	6A 61% 6C 31% 10B 8%	7D 100%	72	6A 61% 6C 39%	7E2 3% 12A 97%
Whitetop Laurel Gorge	2C3 17% 4A 78% 7A 3% 7G 2%	4A 76% 4F 12% 6C 5% 7G 2% 8A1 3% 8E6 2%	4A 76% 4F 13% 7A 3% 7E2 3% 10D 5%	4A 17% 4K4 78% 7A 3% 7G 2%	1,199	2C3 18% 4A 77% 6C 5%	4K5 93% 7A 3% 7G 4%
Little Laurel Creek	4F 95% 7B 5%	6A 70% 6C 26% 9H 4%	6A 70% 6C 26% 10B 4%	4F 95% 7B 5%	195	6A 70% 6C 26% 8A2 4%	6A 69% 6C 26% 7E1 5%
Apple Orchard Falls	7D 66% 7F 34%	4B2 100%	4K1 100%	2C3 28% 4K1 72%	1,714	4B2 100%	4K1 99% 8E2 1%
Little Wolf Creek	1B 100%	1B 100%	4A 39% 10A 61%	1B 100%	472	1B 100%	1B 100%
Cave Springs	7E2 2% 8C 93% 9F 5%	4D 3% 6C 4% 8A1 4% 8A2 60% 9F 5% 9H 24%	8C 31% 9F 5% 12B 64%	9F 5% 12B 95%	3,300	9F 5% 12C 95%	1B 100%
Helton Creek	7B 100%	9B3 100%	9B3 88% 10D 12%	4F 100%	313	9B3 100%	1B 100%
Stone Mountain	1B 100%	1B 100%	1B 100%	1B 100%	103	1B 100%	1B 100%

Alternative D

The Special Areas would be expected to retain the unique resources, qualities and/or characteristics that resulted in their identification in the 1985 Plan. About 3% of their total area would be in management prescriptions suitable for timber management (10A, 10B, and 10D). Rare communities (9F) would be managed in the Peters Mountain Bogs and Cave Springs areas. Little Wolf Creek, Hipes Branch, and Stone Mountain are Recommended Wilderness Study Areas (1B). About 31% of the Cave Springs area would be suitable for timber management (8C) under this alternative.

Alternative E

All of the Special Areas would be allocated to management prescriptions retaining their unique resources, qualities and/or characteristics. Little Wolf Creek, Hipes Branch, and Stone Mountain are Recommended Wilderness Study Areas (1B). Roaring Branch Gorge, Guest River Gorge, and Apple Orchard Falls are each allocated wholly or partially to Eligible Wild and Scenic River prescriptions (2C1 or 2C3). Rare communities (9F) would be managed in the Peters Mountain Bogs and Cave Springs areas. Apple Orchard Falls and Whitetop Laurel Gorge are allocated primarily to Special Area prescriptions (4K1 or 4K4) Most of the Cave Springs Area is allocated to Remote Backcountry Recreation Non-motorized (12B).

Alternative F

The current Forest Plan acreage for the Special Areas and wilderness study areas provided the basis for comparing other alternatives. In this no-action alternative, all of the Special Areas would be allocated to management prescriptions retaining their unique resources, qualities and/or characteristics. The Cave Springs area is allocated primarily to the equivalent of Remote Backcountry Recreation Non-motorized (12B); Stone Mountain to Dispersed Recreation (7E2) and Helton Creek to Scenic Corridors (7B).

Alternative G

All of the Special Areas would be allocated to management prescriptions retaining their unique resources, qualities and/or characteristics. Little Wolf Creek, Hipes Branch, and Stone Mountain are Recommended Wilderness Study Areas (1B). Roaring Branch Gorge, Guest River Gorge, and Whitetop Laurel Gorge are each allocated wholly or partially to Eligible Wild and Scenic River prescriptions (2C1 or 2C3), which will protect their outstandingly remarkable values. Rare communities (9F) would be managed in the Peters Mountain Bogs and Cave Springs areas. 95% of the Cave Springs area is allocated to Natural Process in Backcountry Remote Areas (12C).

Alternative I

All of the Special Areas would be allocated to management prescriptions retaining their unique resources, qualities and/or characteristics. Roaring Branch Gorge and Guest River Gorge are allocated to Eligible Wild and Scenic River prescriptions (2C1 or 2C3), which would protect their outstandingly remarkable values. Rare communities (9F) would be managed in the Peters Mountain Bogs. Apple Orchard Falls, Hipes Branch, Whitetop Mountain and Whitetop Laurel Gorge would be allocated entirely or almost entirely to Special Area prescriptions (4K1, 4K2, 4K4, or 4K5). Cave Springs, Helton Creek and Stone Mountain areas are Recommended Wilderness Study Areas (1B).

Summary

All of the Special Areas would be allocated to prescriptions retaining their unique resources, qualities and/or characteristics under Alternatives A, B, E, F, G, and I. Under Alternative D, about 3% of the combined area would be in prescriptions suitable for timber management (7E2, 10A, 10B, and 10D). This could affect small portions of Rush Creek, Whitetop Laurel Gorge, and Little Laurel Creek and a substantial proportion of Little Wolf Creek.

Allocation of the Cave Springs area varies across the Alternatives from a relatively high proportion of suitable acres (7E2, 8C) in Alternative A to recommended Wilderness Study (1B) in Alternative I. All alternatives protect the rare community within this area. Eventual designation of the Cave Springs area as wilderness would provide ecological representation within the Cumberland Mountain Section. Allocation of the Helton Creek area also varies although only Alternative D includes suitable acres (10D). The Stone Mountain area would be allocated to recommended Wilderness Study under all the alternatives except Alternative F.

Several new special areas are identified by some of the alternatives. These include new Special Areas and Scenic Areas. These areas are summarized by alternative in Table 3-136.

Cumulative Effects

Cumulative Effects for all aspects of recreation are summarized at the end of the Recreation Section.

Table 3-136. New Special Area Prescription Allocation by Alternative

Special Areas	4K Special Areas						
	A	B	D	E	F	G	I
North Creek							X
Hoop Hole							X
Mount Rogers Crest Zone							X
Whitetop Mountain							X
Whitetop Laurel Creek							X
North Fork of Pound							X
	4D Special Biologic Areas						
Brush Mountain	X	X	X	X		X	X
Cressy Creek	X	X	X	X		X	X
Dragon's Tooth	X	X	X	X		X	X
Guest River Gorge	X	X	X	X		X	X
High Knob Lake	X	X	X	X		X	X
High Knob NW	X	X	X	X		X	X
Keokee Lake	X	X	X	X		X	X
Mc Falls Creek	X	X	X	X		X	X
Straight Fork	X	X	X	X		X	X
	4E Special Cultural / Historic Areas						
Settlers Museum	X	X	X	X		X	X
Lignite	X	X	X	X		X	X
Fenwick Mines	X	X	X	X		X	X
Glenwood Iron Furnace	X	X	X	X		X	X
	4F Special Scenic Areas						
Devil's Fork							
Pine Mountain	X			X			
Whitetop Mountain	X			X			
Whitetop Laurel Creek	X			X			
Apple Orchard Falls			X	X			
Peters Mountain				X			
Mill Creek				X			
Sinking Creek Mountain				X			

SOCIAL AND ECONOMIC DEVELOPMENT
RECREATION
WILDERNESS AND ROADLESS AREAS

WILDERNESS AND ROADLESS AREAS

Wilderness

Congressionally designated wilderness areas are protected by law and valued for their ecological, historical, scientific and experiential resources.

Currently on the Jefferson National Forest, there are 11 designated wilderness areas containing a total of 57,760 acres or 8 percent of the total forest area. The Jefferson National Forest does not contain any wilderness study areas or recommended wilderness study areas that have not been acted upon by Congress (Table 3-137). The existing wilderness areas will be managed to maintain the areas' natural characteristics. Natural occurrences such as outbreaks of insects or disease are allowed as part of the natural cycle. Natural processes are allowed to operate as freely as possible and human-caused intrusions are very restricted. Under emergency conditions and with appropriate approvals, mechanical equipment and motorized transport may be allowed to control fire that threatens life, property, or the wilderness resource.

Areas that are designated Wilderness are managed for a Primitive (P) recreation opportunity; however, the Jefferson National Forest has no lands that meet the actual Primitive ROS criteria.

Table 3-137. Existing Designated Wildernesses

Wilderness	Acres	Year(s) Designated
Barbour's Creek *	5,382	1988
Beartown	5,609	1984
James River Face	8,886	1975
Kimberling Creek	5,542	1984
Lewis Fork	5,618	1984
Little Dry Run	2,858	1984
Little Wilson Creek	3,613	1984
Mountain Lake	11,113	1984/1988
Peters Mountain	3,328	1984
Shawver's Run*	3,467	1988
Thunder Ridge	2,344	1984
Total	**57,760**	

* Includes 20 acres of Barbour's Creek and 95 acres of Shawver's Run actually on the George Washington National Forest

Roadless

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, item 7.1). 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. Criteria provide for an individual roadless area to include no more than one half mile of improved road for each 1,000 acres.

In the forest planning process, National Forests are required to assess roadless areas on a forest (Chapter 7 of FSH 1909.12). A new roadless inventory was conducted as a part of the Southern Appalachian Assessment, with additional guidelines developed by the SAA team and the Southern Regional Office of the Forest Service to facilitate consistent application of the process.

Following considerable study and debate in the early 1970's, the 1975 Eastern Wilderness Act designated the James River Face Wilderness. This act also designated three wilderness study areas. The RARE II process in the late 1970's resulted in identification of 15 roadless areas, including the three wilderness study areas. The Virginia Wilderness Act of 1984 designated eight of these areas as wilderness and split another one into two wilderness study areas (Barbours Creek and Shawvers Run). These two study areas were designated in 1988, resulting in the current total of 11 wildernesses (Table 3-137).

An updated Roadless Area Inventory was done as part of the 1996 Southern Appalachian Assessment. Over 100 areas forest-wide were considered, including the six remaining RARE II areas, additions to existing wildernesses, and new areas. The Jefferson National Forest Roadless Area Inventory was finalized on 12/17/99 (see 12/17/99 Process Paper). The inventory includes 37 areas totaling 153,119 acres that could be recommended for wilderness study. Three of the areas are shared with the Cherokee National Forest, which administers the majority of all three. The roadless areas included in the inventory meet the criteria as potential wilderness as set forth in Chapter 7 of FSH 1909.12. The Roadless Area Inventory is shown in Table 3-138.

Table 3-138. Inventoried Roadless Areas on the Jefferson National Forest. Acres include National Park Service land and any private land within the area boundary. "CNF" means that the area extends into the Cherokee National Forest but the acres shown are JNF only.

Roadless Area	**Acres**	**Roadless Area**	**Acres**
Barbours Creek Addition	732	Little Wilson Creek Addition A	78
Bear Creek	18,211	Little Wilson Creek Addition B	1,724
Beartown Addition A	1,369	London Bridge Branch (CNF)	853
Beartown Addition B	3,246	Long Spur	5,995
Beaverdam Creek (CNF)	1,133	Mottesheard	6,555
Broad Run	10,916	Mountain Lake Addition A	1,467
Brush Mountain	5,920	Mountain Lake Addition B	4,017
Brush Mountain East	4,895	Mountain Lake Addition C	494
Brushy Mountain	4,118	North Fork Pound	4,718
Garden Mountain	3,962	North Mountain	8,359
Hoop Hole	4,643	Patterson Mountain	4,862
Hunting Camp Little Wolf Creek	8,940	Peters Mountain Addition A	1,570
James River Addition	1,121	Peters Mountain Addition B	2,903
Kimberling Creek Addition A	89	Price Mountain	9,121
Kimberling Creek Addition B	195	Raccoon Branch	4,384
Lewis Fork Addition	748	Rogers Ridge (CNF)	180
Little Dry Run Addition	2,205	Seng Mountain	6,455
Little Horse Heaven	4,722	Shawvers Run Addition	1,926
Little Walker Mountain	9,761	**Total**	**152,587**

Generally, these areas offer a semi-primitive non-motorized (SPNM) recreation opportunity. Any portion of the inventoried areas that falls within ½ mile of an improved road would fall into the Forest's Roaded Natural (RN) ROS class.

For each roadless area, a report was prepared that evaluates its wilderness potential. These reports are found in Appendix C and are in accord with 36 CFR 219.17. The evaluation reports consider wilderness potential in three main categories: capability—the qualities that make a roadless area suitable or not suitable for wilderness; availability – an assessment of the non-wilderness resources and demands of the area; and need—a consideration of the amount of wilderness already in the area, region and nation.

Outdoor recreation is one of the benefactors of wilderness and is one of the drivers of wilderness demand and wilderness management. According to trend data collected from 1965 to 1994 (Cordell 1999), the trend in recreation visits to National Forest Wilderness has paralleled designations and increased over time. In the Southeast, participation rates and trends in wilderness indicate a continued increase in visitation to wilderness with an estimated 5,636,800 visits to wilderness by the year 2050 (see Table 3-119 in Developed and Dispersed Recreation discussion).

In addition to outdoor recreation in wilderness, there is a non-user component that values American wilderness and is important to understand when analyzing wilderness and roadless allocations. Wilderness is valued for preserving representative natural ecosystems and local landscapes and for research. The very existence of wilderness is valued by the American public as part of the natural heritage of the country. The National Survey on Recreation and the Environment (NSRE, 2001) found that 69.8% of those surveyed agreed or strongly agreed to the question, "How do you feel about designating more federal lands in your state as wilderness?" Over 96% agreed or strongly agreed with the statement, "I enjoy knowing that future generations will be able to visit and experience wilderness areas."

Annual visits to wildernesses on the Jefferson National Forest have been estimated at 42,830 based on the National Visitor Use Monitoring survey (USDA Forest Service 2001) done in 2000. This represents about 3% of the total annual Forest visits.

Direct and Indirect Effects

WILDERNESS

Wilderness has many positive effects. As stated above, wilderness preserves natural systems and provides places of solitude for visitors. However, there are environmental effects within wilderness from many sources. Recreational use can have negative impacts to the quality, character and integrity of the wilderness resource due to overuse. Some of these negative impacts include soil compaction; vegetation loss due to disturbance and/or replacement by non-native species such as noxious weeds on trails and campsites caused by heavy recreation use; crowding and loss of solitude; deterioration of water quality from improper disposal of human waste and waste water; and loss of or threats to biological/ecological processes and biodiversity, through human disturbance.

Other environmental effects which impact the integrity of the natural systems in wilderness include air pollution from outside sources, interruption of natural functioning ecosystems by fire suppression, and threats to native plant species from the spread of noxious weeds from sources outside wilderness.

No significant new management direction is being proposed for any of the existing 11 designated wilderness areas on the forest under any of the alternatives so there are no significant direct, indirect, or cumulative effects to the existing wilderness resource. Additions to existing wildernesses are proposed under some alternatives by allocating adjacent lands to proposed wilderness study areas. See the roadless discussion below.

ROADLESS

Decisions on the roadless areas have environmental consequences, regardless of whether or not they are allocated to proposed wilderness study. The magnitude of the effects varies by alternative depending upon the number of roadless areas assigned.

Three categories are used to summarize how each roadless area is allocated in the alternatives. These categories are: Recommended Wilderness Study (W); Roadless Areas Maintaining Roadless Characteristics (R); and Roadless Areas Not Maintaining Roadless Characteristics (N). Table 3-139 summarizes all roadless area allocations by category across the alternatives.

Recommended Wilderness Study (1B): Allocation of areas to Recommended Wilderness Study would increase the number of areas managed to allow natural processes to occur, provide for solitude and primitive recreation, and minimize the impacts of man and his activities on the land. Like wilderness, these are areas where the naturalness, undeveloped conditions, and representative ecosystems would be preserved. The highest priority for management would be to preserve the naturalness of the area, pending wilderness designation.

Roadless areas recommended for wilderness study are set aside for future designation as wilderness and are not available for activities such as vegetative management or road construction. These areas are managed much the same as designated wilderness until a final determination is made by Congress as to whether they will be added to the National Wilderness Preservation system. Roadless areas recommended for wilderness study are displayed by alternative in Table 3-140. Table 3-141 displays the ecosystems represented currently by designated wilderness on the forest as well as those that would potentially be added after wilderness studies are completed. These tables include three additional areas recommended for wilderness study in Alternative I and discussed in the Special Areas section.

Direct effects of managing wilderness study areas include maintaining soil, hydrologic and atmospheric conditions prevailing within the areas. Roads will be closed and rehabilitated or allowed to return to natural state. Water quality and air quality should remain high and the imprint of human influence would generally diminish over time.

Table 3-140. Numbers of Areas and Acres Allocated to Recommended Wilderness Study (1B) by Alternative

	Alternative						
	A	B	D	E	F	G	I
Number of areas	16	9	10	24	0	37	15
Acres	28,200	15,600	15,700	81,600	0	156,100	25,200

Table 3-139. Summary of Roadless Area Allocations by Roadless Character by Alternative

Roadless Area	Alternative A	B	D	E	F	G	I
Barbours Creek Addition	N 100%	N 100%	R 6%, N 94%	R 100%	N 100%	W 100%	R 100%
Bear Creek	R 34%, N 66%	R 66%, N 34%	R 60%, N 40%	W 98%, R 2%	R 52%, N 48%	W 100%	R 100%
Beartown Addition A	W 100%	W 100%	N 100%	W 100%	R 51%, N 49%	W 100%	R 100%
Beartown Addition B	R 29% N 71%	W 63% R 37%	R 34%, N 66%	W 63%, R 37%	R42%, N 58%	W 100%	R 100%
Beaverdam Creek (CNF)	R 24% N 76%	R 67%, N 33%	R 67%, N 33%	R 100%	N 100%	W 100%	R 100%
Broad Run	R 37%, N 63%	R 47%, N 53%	R 1% N 99%	R 100%	R 37%, N 63%	W 100%	R 100%
Brush Mountain	R 96%, N 4%	R 100%	R 6%, N 94%	W 100%	N 100%	W 100%	R 100%
Brush Mountain East	R 91%, N 9%	R 97%, N 3%	W 100%	W 69%, N 31%	R 69%, N 31%	W 100%	R 100%
Brushy Mountain	R 99%, N 1%	R 100%	W 99%, R 1%	R 100%	R 67%, N 33%	W 100%	R 100%
Garden Mountain	R 29%, N 71%	R 40%, N 60%	R 37%, N 63%	W 68%, R 32%	R 48%, N 52%%	W 100%	W 87%, R 13%
Hoop Hole	W 100%	R 80%, N 20%	W 78%, N 22%	R 100%	R 58%, N42%	W 100%	R 100%
Hunting Camp Little Wolf Creek	W 95%, R 5%	W 94%, R 6%	R 23%, N 77%	W 96%, R 4%	R 58%, N 42%	W 100%	W 98%, R 2%
James River Addition	W 100%	R 100%	N 100%	R 100%	R 54%, N 46%	W 100%	W 100%
Kimberling Creek Addition A	W 51%, N 49%	R 100%	W 51%, N 49%	W 52%, R 48%	N 100%	W 100%	W 51%, R 49%
Kimberling Creek Addition B	W 100%	N 100%	W 100%	W 100%	N 100%	W 100%	W 100%
Lewis Fork Addition	W 100%	W 46%, R 54%	R 53%, N 47%	W 46%, R 54%	R 100%	W 100%	R 100%
Little Dry Run Addition	W 100%	R 7%, N 93%	N 100%	W 98%, R 2%	N 100%	W 100%	R 100%
Little Horse Heaven	R 100%	R 11%, N 89%	R 11%, N 89%	R 100%	R 63%, N 37%	W 100%	R 100%
Little Walker Mountain	R 24%, N 76%	R 67%, N 33%	R 1%, N 99%	W 99%, N 1%	R 36%, N 64%	W 100%	R 100%
Little Wilson Creek Addition A	W 74%, N 26%	W 74%, R 26%	W 74%, N 26%	W 74%, R 26%	R 100%	W 100%	W 74%, R 26%
Little Wilson Creek Addition B	W 100%	W 91%, R 9%	R 7%, N 93%	W 93%, R 7%	R 100%	W 100%	W 100%
London Bridge Branch (CNF)	N 100%	R 13%, N 87%	R 13%, N 87%	R 100%	N 100%	W 100%	R 100%
Long Spur	R 24%, N 76%	R 100%	R 71%, N 29%	R 100%	R 53%, N 47%	W 100%	R 100%
Mottesheard	N 100%	N 100%	R 20%, N 80%	R 100%	R 35%, N 65%	W 100%	R 100%
Mountain Lake Addition A	W 62%, R 24%, N 14%	R 24%, N 76%	W 76%, R 24%	W 76%, R 24%	R 39%, N 61%	W 100%	W 63%, R 37%
Mountain Lake Addition B	W 96%, N4%	R 2%, N 98%	R 2%, N 98%	W 100%	R 30%, N 70%	W 100%	W 56%, R 44%
Mountain Lake Addition C	W 100%	W 100%	R 4%, N 96%	W 100%	N 100%	W 100%	W 100%
North Fork Pound	N 100%	R 8%, N 92%	R 8%, N 92%	R 8%, N 92%	N 100%	R 8% N 92%	R 8% N 92%
North Mountain	R 37% N 63%	R 35% N 65%	N 100%	R 100%	R 36%, N 64%	W 100%	R 100%
Patterson Mountain	R 51% N 49%	R 77%, N 23%	R 4%, N 96%	R 100%	R 48%, N 52%	W 100%	R 100%
Peters Mountain Addition A	W 82%, R 18%	W 82%, R 18%	W 82%, R 18%	W 72%, R 28%	R 81%, N 19%	W 100%	W 82%, R 18%
Peters Mountain Addition B	W 65%, N 35%	N 100%	R 1%, N 99%	W 92%, R 8%	R 48%, N 52%	W 100%	R 100%
Price Mountain	R 45%, N 55%	R 50%, N 50%	R 1%, N 99%	R 100%	R 44%, N 56%	W 100%	R 100%
Raccoon Branch	R35%, N 65%	R 29%, N 71%	R 31%, N 69%	W 100%	R 64%, N 36%	W 100%	R 100%
Rogers Ridge (CNF)	N 100%	R 82%, N 18%	W 100%	W 100%	N 100%	W 100%	R 100%
Seng Mountain	R 99%, N 1%	R 40% N 60%	N 100%	W 98%, R 2%	N 100%	W 100%	R 100%
Shawvers Run Addition	N 100%	N 100%	N 100%	W 50%, R50%	R 32%, N 68%	W 100%	W 63%, R 37%
Forestwide Totals	W 19%, R 35%, N 46%	W 10%, R 47%, N 43%	W 10%, R 17%, N 73%	W 51%, R 46%, N 3%	W 0%, R 45%, N 55%	W 97%, N 3%	W 14%, R 83%, N 3%

W=Wilderness Study

R=Roadless Areas Maintaining Roadless Character

N=Roadless Areas Not Maintaining Roadless Character

Note: Areas or portions of areas identified as having their roadless character maintained may include prescriptions allowing

Opportunities for solitude and remoteness would increase as would the opportunity for primitive and unconfined recreation due to road closures and prohibiting motorized use. Non-motorized dispersed recreation activities such as hiking, horseback riding, camping, fishing, and hunting would continue and use levels would be expected to remain about the same as currently takes place. Visual and experiential contrasts between roadless areas and other timbered lands would increase. Allocating wilderness study areas would essentially increase the total wilderness recreation carrying capacity, allowing enhanced opportunities for solitude, challenge, and primitive recreation experiences. However, road closures would result in decreased access for some activities. A decrease in opportunities for bicycling, off-highway vehicles and other forms of recreation requiring motorized transport or mechanized equipment would result. Bicycle and motorized use would be displaced to other areas.

Table 3-141. Ecosystems represented by Wilderness or Wilderness Study areas by Alternative

Section / Subsection Names	**Number of Areas by Alternative**													
	A		**B**		**D**		**E**		**F**		**G**		**I**	
	W	WS	W	WS	W	WS	W	WS	W	WS	W	WS	W	WS
Blue Ridge Section/ Northern Blue Ridge Sub-section	2	1	2	0	2	0	2	0	2	0	2	1	2	1
Blue Ridge Section/ Southern Blue Ridge Sub-section	3	5	3	4	3	3	3	8	3	0	3	11	3	3
Northern Ridge and Valley Section/ Ridge and Valley Subsection	6	10	6	5	6	7	6	16	6	0	6	25	6	10
Cumberland Mountains/ Black Mountains	0	0	0	0	0	0	0	0	0	0	0	0	0	1
Total	**11**	**16**	**11**	**9**	**11**	**10**	**11**	**24**	**11**	**0**	**11**	**37**	**11**	**15**

W=Wilderness

WS=Wilderness Study Areas

Table 3-142 shows, by alternative, the miles of system trail that would be closed to bicycle and/or motorcycle use by allocation of roadless areas to recommended wilderness study. Bicycle use is the most heavily affected across the alternatives. The motorcycle trails affected are within the Mount Rogers NRA. Alternative G has the greatest impact on bicycle use due to the highest number of roadless areas recommended for wilderness study.

Table 3-142. Miles of Trails to be Closed to Bicycles and Motorcycles by Alternative under Management Prescription 1B

	Alternative (miles)						
	A	**B**	**D**	**E**	**F**	**G**	**I**
Bicycles	15.4	0.0	8.7	57.1	0.0	120.2	5.9
Motorcyles	4.2	0.0	0.0	4.2	0.0	4.2	0.0
Total	19.5	0.0	8.7	61.3	0.0	124.3	5.9

Bicycles are also allowed on closed roads in Jefferson National Forest, unless otherwise specified. Table 3-143 enumerates miles of road inside Roadless Areas that would be decommissioned and thus closed to motorized and bicycle use if allocated to Recommended Wilderness Study. Alternative G would close the highest number of miles, in 22 separate areas.

Table 3-143. Miles of interior roads to be closed in 1B Areas by Alternative

	Alternative						
	A	B	D	E	F	G	I
Miles	5.7	6.0	3.4	31.3	0.0	61.0	7.7

Maintenance of trails and facilities, including the Appalachian Trail and associated shelters sites would be done using hand tools only and access would be made using non-mechanized/non-motorized means. The minor amount of developed recreation use and other use associated with motor vehicles currently taking place in these areas would cease. Access would be made using non-mechanized/non-motorized means. This could potentially affect up to 30 miles of the AT, two miles of proposed of AT relocation, five existing shelters, 1-2 potential shelter reconstructions, one potential shelter relocation in eight different roadless areas over a range of four alternatives (A, E, G and I). The minor amount of developed recreation use and other use associated with motor vehicles currently taking place in these areas would cease, except in those portions specifically excluded from the area boundary. (See Appendix C)

Research (Cordell 1999) indicates that additional wilderness would potentially increase National Forest visitation. This, in turn, would increase economic benefits resulting from tourism in the surrounding local communities. However, there would also be a reduction in economic benefits associated with the management, harvesting, manufacturing and retail sale of timber products from these areas since timber management activities would not be allowed. There would be reduced opportunities to recover commercial minerals and mineral exploration and development will be hindered.

Within the 37 roadless areas, there are currently 45,261 acres identified as suitable for timber production. As shown in Table 3-144, Alternative G would affect the largest total area of suitable land within areas recommended for wilderness study. Alternative B (39%) contains the largest proportion of suitable acres within recommended roadless areas among the alternatives.

Inventory data indicates privately owned mineral rights underlying 7,650 acres of Federal surface ownership within 16 roadless areas. As shown in Table 3-144, Alternative G has the greatest amount of acreage and number of areas with privately owned subsurface mineral rights. Among the alternatives with recommended wilderness study areas (A, B, D, E, G, and I), the percent of total of roadless acreage with private subsurface mineral ownership ranges from 4% (Alternative D) to 15% (Alternative B). Within the same group, the percent of areas with privately owned minerals ranges from 25% (Alternative D) to 63% (Alternative B). Requests for access to these interests would be recognized and reasonable access granted. There is, however, a low potential for this occurring. The potential for development of energy minerals and other leasable and common minerals is estimated to be low. There are no existing federal oil or gas leases or other Federal mineral leases in effect in any of the areas recommended for wilderness study. These areas are administratively unavailable for federal oil and gas and other federal mineral leases, pending final Congressional action. These areas are not available for mineral materials for commercial purposes. Administrative use of mineral materials is allowed but use and impacts would be extremely low.

Table 3-144. Potential Timber Management and Private Mineral Rights affected by 1B Areas by Alternative

	Number of Areas by Alternative													
	A		B		D		E		F		G		I	
	Acres	%	Acres	%	Acres	%	Acres	%	Acres	%	Acres	%	Acres	%
Lands Tentatively Suitable for Timber Production	9,956	33%	7,065	39%	3,070	18%	29,821	35%	0	0%	45,221	30%	9,311	33%
Private Mineral Rights	2,523	8%	2,706	15%	648	4%	5,597	7%	0	0%	6,724	5%	1,340	5%
	No.	%	No.	%	No.	%	No.	%	No.	%	No.	%	No.	%
Number of 1B Areas with Private Mineral Rights	5	33%	5	63%	2	25%	12	52%	0	0%	15	42%	5	38%

Several of the roadless areas contain wildlife openings managed by mowing, constructed wildlife ponds or special habitat management areas. Some contain programs for fisheries stocking, restoration, or habitat structures. A few of the 37 areas contain TES species, rare plants or rare communities. The significance of the effects on these resources depends upon the number of areas and the kinds and intensity of activities in the areas. See Table 3-145.

Table 3-145. Wildlife, Fisheries and Plants Potentially Affected by 1B Areas by Alternative

Alt A	1 mile linear wildlife opening and 13 waterholes in James River Face Addition; 36 acres of openings, and one water hole and several stream habitat improvements in Little Dry Run Addition
Alt B	152 acres of wildlife openings and two waterholes in Beartown B
Alt D	5 acres of wildlife openings in Brush Mountain
Alt E	326 acres wildlife openings; six wildlife ponds; 50 acre gray squirrel habitat area; two TES species in nine areas
Alt F	No areas proposed for Wilderness Study
Alt G	365 acres wildlife openings; approx. 3 miles linear wildlife openings; 50 acre gray squirrel habitat area; 24 wildlife ponds, at least three TES species in 15 areas
Alt I	29 acres of wildlife openings and 1 TES species in Shawvers Run; 1 mile linear wildlife opening and 13 waterholes in James River Face Addition

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The naturalness, uniqueness, and representative ecosystems of the designated areas would be maintained. Natural ecological processes would continue including plant succession. Larger blocks of undeveloped land and reduction in open road density in areas recommended for wilderness study will favor area sensitive and disturbance sensitive species. Existing old fields, wildlife openings and other habitat improvements for fish and wildlife would not be maintained in prescriptions areas recommended for wilderness study. These early successional habitat areas will succeed to forest. New permanent wildlife openings would not be created. These factors would reduce habitat for early successional species. Fish stocking in areas recommended for wilderness study would be restricted to reestablishment or maintenance of indigenous, threatened, endangered, or sensitive species with Forest Supervisor authorization. Rare communities and threatened and endangered species would be managed within the limitation of activities allowed within wilderness study areas.

Special uses occur in 15 of the 37 roadless areas. These include a powerline, a gas pipeline, a rain gauge, access roads, waterlines and spring box permits for domestic water, fences, grazing, and outfitter recreation-related permits for endurance and bike races. Some of these may be allowed in Wilderness Study Areas; others will need to be excluded from individual area boundaries. Future permits may be restricted by allocations to 1B.

Educational opportunities for the scientific study of natural ecological processes would increase.

Fire management may be affected by designation of additional wilderness areas. Fire suppression of all human-caused wildland fires would minimize the potential effects on wilderness values, however fires in these areas would likely become larger in size than they would under current management because of the restrictions on motorized equipment such as dozers. Under emergency situations, mechanized equipment and motorized transport, use of helicopters, air tankers, and other aircraft may be approved by Forest Supervisors and/or Regional Forester. These actions would impact wilderness character and visitor experiences and leave evidence of man, although rehabilitation could help to reduce those impacts afterward.

Lightning-ignited fires, if allowed to burn, enhance the natural systems that are fire-dependant. It would benefit recreation by opening up the forest, reducing fuel loading to acceptable levels, and maintaining the vegetation. There would be a short-term negative impact to air quality, visual aesthetics and possibly water quality.

Management-ignited fires to reduce hazardous fuels can have negative results in wilderness through changes in vegetation types, impacts to wilderness visitors and experiences, water quality and habitat within wilderness. It can however benefit the wilderness by reducing fuel loadings to acceptable levels such that naturally ignited fires may be returned to the wilderness or wilderness study area. Fire prevention strategies applied in the urban interface area on private land can reduce the need for management-ignited fires.

Several of the areas have a history of wildland fire, either naturally ignited or human-caused. All or a portion of the acres in each of these areas would be included in the Forest's planned prescribed burning program. A Wilderness Study (1B) designation would eliminate this management activity.

Additional human-caused effects to wilderness study areas are similar to those found in wilderness such as soil compaction; vegetation loss or disturbance; non-native species introduction; crowding and loss of solitude; deterioration of water quality from improper disposal of human waste and waste water; and loss of or threats to biological/ecological processes and biodiversity, through human disturbance.

ROADLESS AREAS MAINTAINING ROADLESS CHARACTER

Areas identified in this EIS as Roadless Areas Maintaining Roadless Character, are those that will still qualify for placement on the roadless (or potential wilderness) inventory according to the criteria in Forest Service Handbook 1909.12, Chapter 7, Section 7.11, when the Jefferson Forest Plan is revised again in 10-15 years. In other words, future options for recommending these areas as wilderness study will not be forgone. Management activities that could affect roadless character include timber harvesting, planting of non-native vegetation, mineral development that involves surface occupancy, changes in land ownership pattern, or construction of improvements like buildings, fences, roads, transmission lines, communication installations, or campgrounds.

Criteria for roadless areas in the east are enumerated in Section 7.11b of Chapter 7. An area can contain improvements providing they are disappearing or muted, up to ½ mile of improved Forest Service road for each 1,000 acres, up to 15% of the area in non-native planted vegetation, and timber harvesting within the last ten years affecting up to 20% of the area. As long as an area still meets these criteria the next time a roadless inventory is conducted, it will still qualify for placement on the roadless inventory and can still be evaluated for recommendation as wilderness.

In Alternatives A, B, D, and F the following management prescriptions will maintain roadless character throughout the life of this Forest Plan: 1A, 1B, 4A, 4B2, 4K2, 4K3, 4K4, 6A, 6B, 6C, 8E2a, 8E2b, 8E4a, 9F, 12A, 12B, and 12C. Management prescriptions 1A and 1B are congressionally designated wilderness and recommended wilderness study, respectively. Management prescription 8E2b is suitable for timber production, but no more than 100 acres per year averaged over a 5-year period may be cut (Standard 8E2-022). Management prescriptions 8E2a, 8E2b, and 12A allow temporary road construction, which would be disappearing or muted within 2-3 years (based on average life span of a temporary road of 1-2 years). Although, management prescriptions 4A, 6B and 6C allow limited timber harvest, road construction, and oil and gas leasing with additional stipulations, these allowances would not affect roadless character due to the fact that these areas are influenced by the larger prescription areas that surround them and would not, in and of themselves, cause an area to not meet the criteria for roadless areas in the east. In other words, a forest manager would not construct a road or manage vegetation using timber harvest in these areas when they are embedded within a larger management prescription that prohibits these activities. In the case of 4A and 6C, roads are only permitted when there is no other alternative.

In Alternatives E, G, and I, inventoried roadless areas are allocated to a Recreation Opportunity Spectrum classification of semi-primitive non-motorized (SPNM), semi-primitive motorized (SPM), or semi-primitive 2 (SP2). SP2 is a new sub-classification of semi-primitive (non-motorized and motorized) derived during the current forest planning process to buffer and protect the remote characteristics of SPNM and SPM. Within inventoried roadless area boundaries, all NFS lands that were not inventoried as SPNM or SPM were designated SP2. Forestwide Standards 162-167 ensure that all semi-primitive characteristics and values are protected regardless of the management prescription assigned to these areas, therefore the roadless character of all inventoried roadless areas (with the exception of the North Fork of the Pound) are maintained in Alternatives E, G, and I. The North Fork of the Pound inventoried roadless area is currently under an active oil and gas lease held by production. The company holding this lease has plans to explore and possibly develop the oil and gas resources within this area, therefore the roadless character of this area may not be maintained throughout this planning period. However,

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the long-term desired condition for the North Fork of the Pound is to restore its semi-primitive settings and roadless character following expiration of the mineral lease.

Within roadless areas where roadless character is maintained, sights and sounds of human activities may increase and some opportunity for solitude may be diminished due to a broader range of activities under the various management prescriptions assigned. Existing roads and motorized trails remain open in all these management prescriptions except 1B, 12B, and 12C. Some recreation trails, trailheads, bulletin boards, etc. may be constructed to enhance the visitor's experience. This may include hardened horse trails and bicycle trails. Prescribed fire may be used to restore native communities and species or reduce hazardous fuels, therefore some mechanized/motorized equipment and vehicles use may be necessary to construct firelines and hold the fireline during burning operations (except in 1B and 12C where these methods are prohibited).

Although all management prescriptions that maintain roadless character (with the exception of 8E2b as previously described) are unsuitable for timber production, limited timber harvesting may occur in some of these management prescriptions for insect/ disease control, salvage of dead, dying, or deteriorating trees, or to reduce costs associated with vegetation management to achieve the desired condition of the management prescription. Such situations are rare, very specific to each individual management prescription, and will not exceed 4% of these areas, let alone exceed the 20% defined by the criteria. Wildlife improvements (old fields, wildlife openings, linear wildlife strips and waterholes) may continue to be maintained in most management prescriptions that maintain roadless character; however, native species are emphasized when establishing food plants for wildlife. The 30 miles of the Appalachian National Scenic Trail (AT) that cross these areas could be maintained with mechanized equipment, as could the five existing AT shelters. Existing special uses could continue and new uses may be allowed.

Table 3-139 displays by alternative, the percentage of each inventoried roadless area in which roadless character is maintained.

ROADLESS AREAS NOT MAINTAINING ROADLESS CHARACTER

In this category, management prescription allocations are made which allow timber harvesting, planting of non-native vegetation, mineral development that involves surface occupancy, changes in land ownership pattern, or construction of improvements like buildings, fences, roads, transmission lines, communication installations, and/or campgrounds. In other words, future options for recommending these areas as wilderness study may be forgone. Management prescription allocations in a Forest Plan do not necessarily commit an area to development. Before a decision is made to actually conduct one of these activities (for example: build road or harvest timber) in a roadless area, a site-specific analysis must be conducted.

The roadless character in these areas may be diminished over time. The naturalness of these areas may be reduced by the interruption of natural ecological processes. Vegetation composition and structure may be manipulated resulting in a greater diversity of age-classes among forest types. Opportunities for solitude and remoteness may decrease. Sights and sounds of human activities may be more obvious. Additional roads and trails may be constructed. Noise levels and soil erosion may increase and air and water quality may decrease but water quality will meet State and Federal standards.

ADDITIONAL WILDERNESS STUDY AREAS

Three areas (Cave Springs, Helton Creek and Stone Mountain) were not included in the roadless area inventory but are recommended for Wilderness Study under Alternative I. These are discussed in the Special Areas section of the EIS. An evaluation for potential wilderness has been done for each of these areas and is found in the process files.

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 (Roadless Rule) 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 Roadless Rule prohibits new road construction and reconstruction in inventoried roadless areas on National Forest System lands, except:

- ▶To protect health and safety in cases of an imminent threat of flood, fire, or other catastrophic event that, without intervention, would cause the loss of life or property.
- ▶To conduct environmental clean up required by federal law.
- ▶To allow for reserved or outstanding rights provided for by statute or treaty.
- ▶To prevent irreparable resource damage by an existing road.
- ▶To rectify existing hazardous road conditions.
- ▶Where a road is part of a Federal Aid Highway project.
- ▶Where a road is needed in conjunction with the continuation, extension, or renewal of a mineral lease on lands that are under lease, or for new leases issued immediately upon expiration of an existing lease.

The Roadless Rule prohibits the cutting, sale, and removal of timber in inventoried roadless areas, except:

- ▶For the cutting, sale, or removal of generally small diameter trees which maintains or improves roadless characteristics and:
- ▶To improve habitat for threatened, endangered, proposed, or sensitive species, or
- ▶To maintain or restore ecosystem composition and structure, such as reducing the risk of uncharacteristic wildfire effects.
- ▶When incidental to the accomplishment of a management activity not otherwise prohibited by this rule.
- ▶For personal or administrative use.
- ▶Where roadless characteristics have been substantially altered in a portion of an inventoried roadless area due to the construction of a classified road and subsequent timber harvest occurring after the area was designated an inventoried roadless area and prior to the publication date of this rule.

In this EIS, the inventoried roadless areas were evaluated for possible wilderness study area recommendations. If areas were not recommended for wilderness study designation, other land allocations were considered for these areas, depending upon the overall emphasis of each plan alternative. In some alternatives, a particular roadless area's characteristics would be maintained, while in other alternatives, the area's roadless characteristics could be altered as described in the previous section of this EIS. Whether an inventoried roadless area meets the intent of the Roadless Rule is a separate and different analysis from whether an area's roadless character is maintained. A certain level of timber harvest (20%) and a specified mileage of improved road (½ mile per 1,000 acres) can exist in roadless areas in the eastern United States and still meet the criteria for placement on the roadless (or potential wilderness) inventory (FSH 1909.12, Chapter 7).

The list of management prescriptions that meet the intent of the Roadless Rule is different from the list of management prescriptions that maintain roadless character. The special standards added to Alternatives E, G, and I to protect semi-primitive areas allow timber harvesting and temporary road construction, while important for maintaining roadless character, do not meet the intent of the Roadless Rule. Therefore, the percent of inventoried roadless areas that maintain their roadless character under each alternative is different than the percent of inventoried roadless areas that meet the intent of the Roadless Rule.

The following management prescriptions have been determined to meet the intent of the Roadless Rule, with exceptions: 1A, 1B, 2C1, 4A, 4F, 4B2, 4K2, 4K3, 4K4, 4K6, 6A, 6B, 6C, 8E2a, 8E4a, 9F, 12B, and 12C. All of these prescriptions are unsuitable for timber production, generally prohibit roadbuilding, and are withdrawn, administratively unavailable, or contain no surface occupancy stipulations for mineral leasing. Although timber harvesting and roads may be allowed in these areas in certain limited situations, the desired conditions of these prescriptions can be achieved without these activities.

The following describes by alternative, what would happen to these land allocations should the Roadless Area Conservation Rule restrictions go into effect.

Alternative A

Under this alternative, 54% of the acres in the inventoried roadless areas are either recommended for wilderness study designation or are allocated to management prescriptions that would be consistent with the Roadless Rule including exceptions. The remaining 46% of the inventoried roadless areas are allocated to management prescriptions allowing road building and/or timber harvesting activities. These activities would not be consistent with the Roadless Rule including exceptions and would, therefore, be forgone with the Roadless Rule in effect.

Alternative B

Under this alternative, 57% of the acres in the inventoried roadless areas are either recommended for wilderness study designation or are allocated to management prescriptions that would be consistent with the Roadless Rule including exceptions. The remaining 43% of the inventoried roadless areas are allocated to management prescriptions allowing road building and/or timber harvesting activities that would be conducted for the purposes of wildlife habitat improvement or improving forest health. These activities would not be consistent with the Roadless Rule including exceptions and would, therefore, be forgone with the Roadless Rule in effect.

Alternative D

Under this alternative, approximately 26% of the acres in the inventoried roadless areas are either recommended for wilderness study designation or are allocated to management prescriptions that would be consistent with the Roadless Rule. The remaining approximately 74% of the acres in the inventoried roadless areas are allocated to management prescriptions allowing road building and/or timber harvesting activities. These activities would not be consistent with the Roadless Rule including exceptions and would, therefore, be forgone with the Roadless Rule in effect.

Alternative E

Under this alternative, 72% of the acres in the inventoried roadless areas are either recommended for wilderness study designation or are allocated to management prescriptions that would be consistent with the Roadless Rule including exceptions. The remaining 28% of the inventoried roadless areas are allocated to management prescriptions allowing temporary road building and/or timber harvesting activities that would be conducted for the purposes of wildlife habitat improvement or improving forest health. These activities would not be consistent with the Roadless Rule including exceptions and would therefore, be forgone with the Roadless Rule in effect, however the roadless character is maintained in all inventoried roadless areas through the application of standards allowing only temporary road construction.

Alternative F

Under this alternative, 38% of the acres in the inventoried roadless areas are allocated to management prescriptions that would be consistent with the Roadless Rule including exceptions. The remaining 62% of the inventoried roadless areas are allocated to management prescriptions allowing road building and/or timber harvesting activities. These activities would not be consistent with the Roadless Rule including exceptions and would, therefore, be forgone with the Roadless Rule in effect.

Alternative G

Under this alternative, 100% of the acres in the inventoried roadless areas are either recommended for wilderness study designation or are allocated to management prescriptions that would be consistent with the Roadless Rule including exceptions.

Alternative I

Under this alternative, 77% of the acres in the inventoried roadless areas are either recommended for wilderness study designation or are allocated to management prescriptions that would be consistent with the Roadless Rule including exceptions. The remaining 23% of the inventoried roadless areas are allocated to management prescriptions allowing temporary road building and/or timber harvesting activities that would be conducted for the purposes of wildlife habitat improvement or improving forest health. These activities would not be consistent with the Roadless Rule including exceptions and would, therefore, be forgone with the Roadless Rule in effect, however the roadless character is maintained in all inventoried roadless areas through the application of standards allowing only temporary road construction.

Cumulative Effects

Cumulative Effects for all aspects of recreation are summarized at the end of the Recreation Section.

SOCIAL AND ECONOMIC DEVELOPMENT

RECREATION

NATIONAL WILD AND SCENIC RIVERS

NATIONAL WILD AND SCENIC RIVERS

The Wild and Scenic Rivers Act (Public Law 90-542: 16 USC 1271-1287, October 2, 1968) and its amendments provide for the protection of selected rivers and their immediate environments. To be eligible for designation rivers must possess one or more outstandingly remarkable scenic, recreational, geologic, fish and wildlife, historic, cultural, or other similar values. Designation preserves rivers in free-flowing condition, protects water quality and protects their immediate environments for the benefit and enjoyment of present and future generations.

Most rivers are added to the National Wild and Scenic Rivers System (National System) through federal legislation, after a study of the river's eligibility and suitability for designation. The Forest Service is required to consider and evaluate rivers on lands they manage for potential designation while preparing their broader land and resource management plans under Section 5(d)(1) of the Act.

According to the Southern Appalachian Assessment (SAA), the national forests in the Southern Appalachians were established early in the 20th century primarily to protect the headwaters of major rivers from land uses that encouraged flooding, erosion, and stream sedimentation. Some would argue that clean water for the surrounding cities is the region's most important product. The Southern Appalachians contain parts of 73 major watersheds; 29 are wholly within the SAA region, 18 have more than one-half within the region. Nine major rivers that rise in the Southern Appalachians provide drinking water to the major cities in the Southeast.

Rivers and stream corridors accommodate a lot of different uses such as picnicking, fishing, day hiking and walking for pleasure, primitive camping, boating (canoeing, kayaking, rafting, tubing), swimming and nature study. The National Survey on Recreation and the Environment 2000 interviewed over 15,000 people to determine participation in a variety of activities. According to the results, 76.1 reported participating in boating (including rafting, kayaking and canoeing) and 20 million participated in rafting, tubing or any other type of floating on flowing waters. Over 27 million reported fishing in cold water streams, rivers and lakes for trout. According to the SAA Social, Cultural, and Economic Technical Report, trends in the percentage of participation in all of these activities increased from 1972 to 1992. The largest increases in participation over the 20 years occurred in pleasure walking (34.3%), nature study (25.3%) and day hiking (16.9%).

Demand for Wild and Scenic River (WSR) designation is expressed primarily through public comment and responses to agency proposals. The degree to which public input favors designation indicates the demand for a wide range of uses, activities, and resources qualities associated with WSR management. Although demand is closely related to the current population and the projected growth of the local area, WSR designation would likely produce increased levels of recreation use in designated and potential WSR corridors.

The Southern Appalachians currently have five Wild and Scenic Rivers totaling 191.1 miles. All but 45.3 miles are managed by the national forests. Of the 145.8 miles of designated river managed by the forest service, 80.8 miles are classified as wild, 34 miles as scenic and 31 miles as recreational.

No streams were identified on the Jefferson National Forest in the National River Inventory (NRI) at the time of the completion of the current Jefferson National Forest Plan in 1985 so none were studied during that planning process. There are no Congressionally designated Study Rivers within the forest.

Forest Service Handbook 1909.12, Chapter 8 gives direction for identification and evaluation of rivers for potential designation. Early in the current forest planning process, 14 streams within the Jefferson National Forest were identified for evaluation. Russell Fork was the only stream identified in the Nationwide River Inventory (NRI) as of 1993. A Forest Service evaluation team consisting of forest and district personnel, who consulted with specialists both internally and externally, identified the other 13 streams. External consultants included representatives from several state agencies, academia, and river conservation organizations. For this forest plan revision, of the 14 streams suggested and reviewed for potential WSR eligibility, ten were found to be eligible based on their outstandingly remarkable values. These streams were classified according to Section 2 of the WSR act (PL 90-542). Appendix D outlines more information on the evaluation process. Table 3-146 shows the sections and their recommended classifications.

Table 3-146. Rivers Eligible as National Wild and Scenic Rivers

River	County, State	Total	Length NFS Ownership *Left Bank	NFS Ownership *Right Bank	Preliminary Classification
Little Stony Creek	Giles, VA	3.2	3.2	2.8	Rec
Stony Creek	Giles, VA	8.3	7.0	6.0	Rec
Clinch River	Scott, VA	5.5	0.4	0.0	Rec
Guest River	Scott, VA	6.5	3.5	1.7	Rec
Little Stony Creek	Scott, VA	8.5	8.5	8.5	Rec
Roaring Branch	Wise, VA	3.0	3.0	3.0	Wild
Russell Fork[1]	Dickenson, VA & Pike, KY	8.7	0.0	4.4	Rec
James River	Botetourt, Rockbridge, Amherst, & Bedford, VA	23.0	10.0	0.0	Rec
North Creek	Botetourt, VA	7.0	7.0	7.0	Rec
Whitetop Laurel/ Green Cove Creeks	Washington, VA	12.0	10.5	10.0	Rec

* Left and Right banks looking upstream

[1] Breaks Interstate Park ownership is left bank 6.5 miles and right bank 3.1 miles

Direct and Indirect Effects

ELIGIBLE RIVERS

The identification of a river for study through the forest planning process does not trigger any protection under the Act until designation by Congress. Importantly, identifying rivers as eligible, or eligible and suitable, does not create any new agency authority; rather, it focuses the management actions within the discretion of the Forest Service on protecting identified river values. For agency-identified study rivers, the preliminary (inventoried) classification is to be maintained absent a suitability determination. The recommended classification is to be maintained throughout the duration of the forest plan. No river suitability studies are undertaken with this forest plan revision.

Under all alternatives, management emphasis for the eligible rivers and their corridors is focused on protection and enhancement of the values for which they were recognized, without limiting other uses that do not substantially interfere with public use and enjoyment of those values.

In general, the free flowing condition and outstandingly remarkable values (ORVs) determined for the affected eligible rivers will be protected under all alternatives regardless of recommendations from suitability studies. River corridors have been allocated to management prescriptions that adequately protect or enhance the identified ORVs and free flowing condition. The protection provided is one-quarter mile on each side of an eligible river (one-half mile total). Table 3-147 lists the Outstandingly Remarkable Values for each eligible river. Table 3-148 shows the management prescriptions allocated to each river corridor by alternative. Prescription 11, Riparian Corridors is embedded in all prescriptions across alternatives and is not represented in the table.

Table 3-147. Outstandingly Remarkable Values (ORVs) of Eligible Rivers

		Outstandingly Remarkable Values						
River	**Length**	**Scenic**	**Recrea-tional**	**Aquatic**	**Wildlife**	**Cultural**	**Botanic**	**Geologic**
Little Stony Ck NRV	3.2	B	B					B
Stony Creek	8.3			A				
Clinch River	5.5					B	A	B
Guest River	6.5	B	B			B	A	B
Little Stony Ck CRD	8.5	B			B			B
Roaring Branch	3.0	B						B
Russell Fork	8.7	A	B		A	B	A	B
James River	23.0	B	B			B	B	B
North Creek	7.0	B	B					
Whitetop Laurel/ Green Cove Creeks	12.0	B	B					B

A = Nationally Significant

B = Regionally Significant

CLASSIFICATIONS

River classifications do not vary between alternatives. Sections of rivers preliminarily classified as wild will have the highest level of protection. Most impact to Roaring Branch would come from upland activities outside the river corridor. Vegetative management, road construction, and construction or removal of recreation facilities could cause erosion along the river, sedimentation form soil runoff, visual intrusions or noise form nearby activities.

Fire management within the corridor including prescribed fire and fire suppression actions may result in smoke impacts, noise from aircraft, chainsaws and engines, or lasting visual effects from charred vegetation. Search and rescue operations may cause some impact from the use of equipment in the river corridor but these are predicted to be minimal.

Commercial timber harvest would not take place but non-commercial felling of trees could occur to construct and maintain trails. There is a potential for trail and/or trailhead improvement within the Roaring Branch corridor.

Table 3-148. Eligible Wild and Scenic Rivers Prescription Allocations by Alternative

River	Alternative A	B	D	E	F	G	I
Little Stony Creek	2C3	6C, 7D, 8C, 9H	2C3	2C3		2C3	2C3
Stony Creek	1A, 1B, 2C3, 7D, 9F	1A, 1B, 4A, 6C, 7D, 8C, 8E1,9F, 9H	1A, 1B, 2C3, 7D, 8E1, 9F	1A, 2C3, 7D, 9F		1A, 1B, 4A, 6A, 6C, 7D, 8A1, 8C, 9F	1A, 1B, 6C, 7D, 8B, 9A4, 9F
Clinch River	2C3	4F, 6C, 8A1, 9H	2C3	2C3		2C3	2C3
Guest River	2C3	4D, 4F, 9H	2C3	2C3		2C3, 4D	2C3, 4D
Little Stony Creek	2C3, 7B, 7D, 7E2, 10B	7D, 8A1, 9F, 9H	7D, 9F, 10A	2C3, 7B, 7D		2C3, 7D, 8A2	2C3, 7B, 7D, 7E2, 8A1, 8B, 9F
Roaring Branch	2C1, 6A	6A, 6C	6A, 6C	2C1, 7E1		2C1, 8A2	2C1, 7B
Russell Fork	2C3	4F, 6C, 8A1, 9F	4F, 6C, 9F	2C3		2C3	4C1
James River	1A, 2C3, 7B, 9F	1A, 6C, 8A1, 9F, 9G1, 9H	1A, 2C3, 9F, 9H	1A, 2C3, 8A2		1A, 6C, 8A1, 8A2, 9F, 9G1	1A, 7D, 7E1, 7E2, 7G, 8A1, 8B, 8E5, 9F, 9G1
North Creek	4A, 7D, 9F	4A, 7D, 9F	4A, 4K1, 6C, 7D, 8E2a, 8E2b, 9F, 9H, 10A	2C3, 4K1		2C3, 4A, 4B2, 7D, 8A2, 8E2b, 9F	4K1, 7D, 8A1, 8B, 8E2b, 9F
Whitetop Laurel/ Green Cove Creeks	2C3	4A, 4F, 6C, 8A1, 9H	4A, 4F, 6C, 7B, 7E2, 10B	4K4		4A	4K5, 7A, 7G

On the Clinch Ranger District, Roaring Branch, eligible for wild designation, and most of Little Stony Creek, Guest River, and the Clinch River, all eligible as recreational, are underlain by private mineral rights. At some point in the future, it is possible that roads, wells, and other necessary infrastructure associated with these rights may be observed if reasonable access cannot be provided outside of the corridor. River sections preliminarily classified as recreational will be managed with a wider variety of activities allowed within the river corridor. However, management activities would be compatible with the stream's outstandingly remarkable values. In general, scenery would be managed at a higher level of integrity for wild than for recreational streams. Sights and sounds of man's activities would be more apparent in recreational river corridors than in wild river corridors.

Management activities in recreationally eligible river corridors that have the greatest potential of affecting suitability for Wild and Scenic River designation include road construction, limited vegetation management, insect and disease control, permitted utility corridors and mineral extraction. Other activities that could affect the river corridor resources include T&E species habitat management, recreation development, and wildlife and fisheries habitat management.

TOTAL RECREATION PROGRAM CUMULATIVE EFFECTS

A discussion on cumulative effects of the alternatives presented in this EIS examines the how social and land use trends on public and private lands in the Southern Appalachians together influence the healthy and sound management of NFS lands.

As discussed in the DEIS sections dealing with recreation and scenery, overall demand for outdoor recreation opportunities, and the settings that provide them, is increasing and it is increasing at a rate greater than population growth.

The demand for a particular type of recreation activity remains either stable with population growth, or increases more rapidly, depending on the activity. Generally, due to the aging population, the demand for less physically challenging activities, and therefore the demands for developed or improved settings, are likely to rise faster than demands for remote and primitive settings (USDA Forest Service Southern Appalachian Assessment, Summary Report, 1996, p. 37).

Trends on private lands are relevant to Forest Service lands. Currently, public holdings represent one third of the roaded-natural appearing settings and two thirds of remote settings in the Southern Appalachians. These are the preferred settings for outdoor recreation experiences. Due to continuing development of roads and buildings, these settings on privately owned lands are being converted to rural forested settings. The ability for the public to recreate on private lands is changing. About ¼ of private landholders in the Southern Appalachians provide access for the recreating public for certain compatible activities. However, over time, less private land is predicted to be available (USDA Forest Service, Southern Appalachian Assessment, Social Cultural Economic Technical Report, 1996 p.140, 157, 173).

Streams, rivers, and lakes draw people because of water's importance in high quality scenery and the recreation opportunities offered. Today, National Forests are seeing congestion and overuse on many of its waterways. Use is exceeding capacity and public access provided by private lands for water for recreation is diminishing.

Therefore, a general trend on private lands surrounding the Jefferson National Forest is the gradual loss of preferred settings for nature based recreation as well the potential to access private lands. Private lands are not expected to increase the supply for the settings preferred by outdoor recreationists for their activities. As a result, public lands will face most of increasing recreation demand (SFRA, 2002).

Related to recreation demand are tourism and its importance to gateway communities and regional economies. Many communities are encouraging tourism, which includes using the attractions of National Forest to stimulate their local economy. There are numerous examples of this within the Jefferson National Forest market area in not only the larger communities like Roanoke, VA and Greensboro, NC but medium sized towns like Wytheville, VA and small towns like Damascus, VA.

Finally, nature-based settings are key ingredients for enhancing a sense of place in the Southern Appalachian communities. Rapid development of private lands in the South appears to be taking away the sense of place of long-term residents. Local communities identify with landscape features or have cultural practices related to natural settings. Also, traditional uses of the land by residents for hunting, fishing and gathering of natural forest products have transferred in part to NFS lands as private lands become unavailable. Some conflicts exist and will continue to arise between long-time, rural residents and new tourism-related or residential development (Southern Appalachian Assessment, Summary Report, p. 38-40). This is exemplified in the rural southwest Virginia valleys where urban infrastructure intrusions (utility corridors) have led to conflicts between long-time residents and developers.

The primary challenge for recreation managers is how to maintain the integrity of the ecosystems and high quality natural settings as more people bring more impact to the natural setting and want more conveniences. Alternatives A, E, and I emphasize recreation opportunities. Alternatives B, D, and G emphasize other values on National Forest land and therefore provide less recreation opportunities. Alternative E and G encourage more remote settings and more primitive and challenging outdoor recreation with their emphasis on recommendation of new wilderness areas.

Regardless of the alternative selected, recreation demand is increasing and effects will occur. Effects, such as user conflict and resource impacts to riparian corridors, will simply show up sooner in alternatives that do not emphasize recreation opportunities. User controls will be needed, in varying degrees, to protect the health of the natural systems and to maintain an acceptable recreation experience. These controls will begin in current problem areas.

Regardless of alternative selected, it is unknown if future Forest Service budgets will be able to support the recreation staff, law enforcement and facilities (whether for developed or dispersed settings) called for by recreation demand. This is particularly important for high maintenance and operational cost facilities or trail systems such as OHV areas where on-going maintenance and on-the-ground personnel are needed.

For those alternatives that generally emphasize recreation management, there will be a better opportunity to maintain scarce settings, provide high quality recreation experiences and manage impacts on the land. Also there will be a better opportunity to develop tourism linkages and partnerships to support local economies and sound recreation management programs.

HERITAGE RESOURCES

The Jefferson National Forest contains a multitude of sites representing past human events. Beginning with Native American occupations dating as early as 8000 B.C., the variety of cultural resources is impressive. Prehistoric sites include multi-use base camps, transient camps, hunting and gathering stations, quarries, lithic reduction stations, and rock-shelter occupations. The most common site type is often referred to as a lithic scatter and represents a short-term occupation where stone tools were made and/or sharpened and may be associated with a plethora of ancillary activities.

The earliest sites date to the Archaic Period and span the time from 8000 B.C. to 1000 B. C. Throughout this period, small bands of hunters and gatherers occupied both the mountains and the lower elevations exploiting a wide variety of forest resources. As the Archaic period came to an end, exploitation patterns began to focus on the riverine resources with more sedentary sites found along the rivers. This trend continued through the Woodland Period from about 1000 B.C. to A.D. 1650 where the rich alluvial soils were utilized in an intensification of gardening. The raising of horticulture foods, such as corn, beans, and squash, coupled with increased sedentism, led to an increase in population. Hunting and gathering remained important aspects of the economy and the higher elevations continued to be exploited. Native American sites are found throughout the Forest for all time periods with the exception of the Ice Age Paleoindians. Unknown Paleoindian sites may exist on the Forest but have yet to be located.

With the advent of the European occupation of the New World, Native American sites decreased in numbers with a concomitant increase in Euro-American sites. The area that is now the Jefferson National Forest was first explored by the Europeans in the second half of the 17th century and intensive settlement beginning in the second quarter of the 18th century. Welsh, Scotch-Irish, Swedish, and German immigrants traveled down the Great Valley into western and southwestern Virginia. The first historic site types were home and farmsteads closely followed by mills. As extractive industries developed through the 19th century, southwest Virginia became a high producer of iron and timber. Historic sites for this period include log cabins and outbuildings associated with agriculture, cemeteries, mills, schools, iron furnace complexes, mines, colliers pits, logging camps, turnpikes, railroad features and historic landscapes such as Fenwick Mines and the iron town of Lignite. The Jefferson National Forest contains a large number of these historic features as well as later sites relating to the Civilian Conservation Corps that attempted to counter some of the environmental damage brought about by over-exploitation.

Standing structures are also important aspects of the historic era and require proactive management. Significant structures on the Jefferson National Forest include the Green Cove Station, the Konnarock Lutheran Girls' School, the Sullivan Tract 19th century farmstead (Settlers Museum of Western Virginia), High Knob Cabin, Glenwood Furnace, Catawba Furnace, Roaring Run Furnace, and Raven Cliff Furnace.

Heritage resources are important resources that require inventory, evaluation, protection, and interpretation. Cultural resource management was previously viewed as a support function for timber; currently, the trend is toward a resource treatment that recognizes the value of heritage resources in their own right. In order to manage these resources, complete inventories need to be implemented across the Forest. At that point, management alternatives can be developed and National Register of Historic Places nominations completed based on a full regional perspective.

Interpreting cultural resources for the public is an important aspect of heritage resource management. Standing structures readily lend themselves to public education and opportunities exist at the iron furnaces, Green Cove Station, the Settlers Museum of Western Virginia, and the Lutheran Girls' School. Archaeological sites, because of their fragility, are better interpreted off-site. Forest Service visitor information centers, local museums, historical societies, and traveling exhibits offer opportunities for education. The Forest also needs to recognize its responsibility to address research questions and share information with the lay and professional publics.

Direct And Indirect Effects

Direct and indirect affects to historic or cultural resources could result from both natural and human-caused events. These vary depending upon the type of resource, the fragility of the resource, and the type of disturbance, but could include:

- Soil disturbance to varying depths,
- Wildland fire and prescribed fire,
- Vegetation removal,
- Looting or vandalism, and
- Land use changes.

Accordingly, five types of ground disturbing land management activities that vary in magnitude (acres or miles) have the greatest potential to affect heritage resources. These include: timber management, road construction, fire management, mineral management, and recreation use. To a lesser degree, other forms of land management, such as landownership adjustment (land exchange), special use permits, structures management, and wildlife management can also affect heritage resources. A summary of acres of ground disturbing activities is provided in Table 3-149. These are acres in the first decade, so annual figures would be 1/10 of these acres. Direct ground disturbance acres include new Forest Service System road construction for recreation, timber harvest, mineral exploration and development, and other access needs, road reconstruction, skid trails, log landings, pipelines, new recreation developments, new trail construction, and fire lines constructed with heavy equipment like bulldozers.

Table 3-149. Estimated Acres of Ground Disturbing Management Activities by Alternative, First Decade

	Estimated Acres by Alternative						
	A	B	D	E	F	G	I
Direct Ground Disturbance	1,926	1,639	2,329	1,320	2,127	966	1,786
Timber Harvest	20,900	16,200	31,100	10,100	26,000	3,700	16,500
Prescribed Fire (maximum)	14,100	19,300	14,900	9,400	2,900	15,700	15,000

Timber harvests may directly affect unknown significant heritage resources when soil is significantly disturbed by heavy machinery and vehicles, when trees are felled on historic ruins or cemeteries, when logs are skidded across sites, or indirectly when erosion is caused by removal or disruption of vegetation cover or increased surface soil exposure. In general terms, even-aged harvesting may create moderate to heavy disturbance for significant properties located on the ground surface or at shallow depths, and such disturbance may occur over most of the stand or area being harvested. An uneven-aged harvest or single tree selection would similarly disturb the properties located on the surface and in the upper soil matrix, but disturbed areas would be dispersed within the harvest area. As displayed in Table 3-149, Alternative D potentially affects the greatest number of acres through timber harvesting and Alternative G, the least.

With any timber harvest method, the skid trails, log landings, and other areas where vehicle use is concentrated would receive the greatest depth of disturbance and thus provide the most significant direct effects to significant heritage properties and these effects are included in the direct ground disturbance figures in Table 3-149. Indirect affects could include deterioration of sites and artifacts from subsequent erosion and increased site vandalism from increased access and surface exposure of historic sites.

Compliance-related inventories or Phase I inventory surveys would be conducted prior to timber harvest under any timber management program.

New road construction may directly affect unknown sites, given variables specific to each portion of construction. Disturbance within a construction corridor may remove soil containing cultural deposits, depending on the local situation. In cases where fill is added, heritage resources may be buried deeper. This may protect the site from compaction or rutting, while at the same time essentially precluding additional scientific study using conventional technology. Maintenance or reconstruction of existing roads presents less potential for direct effects to intact archeological sites because the majority of damage to an unknown site probably occurred during the original construction. Access to heritage resources provided by roads, however, may result in indirect effects to significant properties by facilitating increased vandalism. Indirect effects also may include erosion of heritage resources subsequent to road construction. Also, artifact exposure during construction could promote site vandalism. Potential effects from road construction and reconstruction are displayed under direct ground disturbance in Table 3-149.

Heritage resources may be directly and indirectly affected by heat damage to artifacts and sites and erosion of sites resulting from wildland fires or fires employed to suppress or control wildland fires (prescribed fires). High-temperature wildland fire could pose direct effects to heritage resources by damaging surface or shallow archeological sites, standing structures, and cemetery markers. Sites of the historic period are most subject to direct effects from these events because many of these properties are more likely to exhibit surface artifacts. Studies show that wildland fire, and in some cases higher temperature prescribed burns, may alter the character and condition of surface artifacts such as melting glass, “crazing” lithic and ceramic artifacts, and burning wood structures. Prescribed fire could also similarly directly affect surface sites or very shallow site deposits and artifacts, but because of reduced temperature, to a much lesser degree than those fires resulting from wildland fire. However, wooden structures and cemetery markers could still be damaged, as could surface artifacts. Alternative B potentially affects the greatest number of acres through prescribed fire and Alternative F, the least.

Fire lines installed with tractor-plow units, whether for wildland fires or prescribed burns, could directly affect heritage resources by physically displacing artifacts located at shallow levels or on the ground. The nature of displacement is primarily laterally, as the plow folds soil and artifacts to each side of the fire line. When multiple parallel fire lines are used for wildland fire control, it would be possible to disturb a large portion of a small site. Fire lines established using a disc harrow would have less impact than those made with a tractor plow. In these cases lateral soil displacement would be minimal, but some fragile surface artifacts or artifacts located in shallow deposits may be broken. Effects from fire lines constructed with heavy equipment are included in the direct ground disturbance figures in Table 3-149. Fires lines installed for prescribed burns are less likely to directly or indirectly affect historic resources since proposed fire plow lines in areas of prescribed burns are inventoried and field surveyed for the presence of heritage resources prior to project implementation. Under normal conditions, however, heritage surveys do not precede emergency fire line construction. Thus, there is a high potential for unknown properties to be affected by wildland fire suppression. Indirect effects following the installation of fire lines and burning may include erosion losses due to the removal or burning of vegetation cover or further deterioration of artifact or feature condition following damage by high temperatures.

Recreation management may be categorized as consisting of three types: concentrated developed recreation areas, dispersed recreation areas, and trails (off road vehicle trails, horse trails, and foot trails). In general, direct effects to significant cultural resources can result from installation of recreation facilities and expansion of recreation facilities and recreation use areas; these effects are included in the direct ground disturbance figures in Table 3-149. Indirect effects could include soil erosion and compaction of heritage resources due to visitor use, and access to given locales could result in archeological site vandalism. These indirect effects could especially occur with illegal expansions off of established off road vehicle trails.

The incidence of vandalism and illicit collection is very much influenced by visitor use.

Greater visitor use to some areas will lead to the increase of vandalism, illicit collection, littering and disturbance to cultural sites under all alternatives. Opening areas to timber production and timber manipulation, recreation use, and roads and trails will result in an increase in site disturbance and vandalism in inaccessible areas that previously were naturally protected from direct, indirect, and cumulative effects. While cultural properties situated in recreation areas and along designated trails and road corridors can be signed, monitored, patrolled and protected, the impacts outside of these areas are largely uncontrolled and the extent of impact unknown. However, the Forest Service does have the authority to close a specific road, trail or area that has considerable adverse effects to cultural resources (36 CFR 295.5, 36 CFR 800.9, and 43 CFR 8342) and prosecute, under 36 CFR 296.4 and other laws, those who willfully destroy or loot significant historic properties.

Even though special use permits involve decreased federal jurisdiction of an area, the potential direct effect to significant heritage resources located in special use areas would be low, in most cases. This is partially due to the small acreages involved in special use areas and the limitations imposed upon special uses for the purposes of resource protection. Indirect effects to significant cultural properties located in special use areas, however, can occur through erosion and vandalism of heritage resources resulting from increased access and use of permit areas.

Analysis of effects to significant cultural resources located on lands placed under special use permit is performed programmatically in compliance with existing laws and regulations (36 CFR 296, 800, and the PMOA with the Tennessee SHPO) and occurs on a case-by-case basis apart from alternatives. As such, effects to heritage resources resulting from special use permits are not affected by alternative.

Exploration and development of leasable minerals, oil, gas, and mineral materials may impact heritage resources through access road construction, pipeline construction, well pad placement, and actual removal and displacement of minerals and soil. Mineral extraction may produce severe, albeit localized, direct effects to significant cultural resources as the overburden containing historic resources are removed. These effects associated with mineral exploration and development are included in the direct ground disturbance figures in Table 3-149. Indirect effects could include damage to significant cultural resources located outside the area of immediate mining resulting from erosion, the installation of road accesses and equipment staging areas, and vandalism and looting resulting from increased access to these historic properties.

Analysis of effects of minerals management to significant cultural resources is performed programmatically in compliance with existing laws and regulations (e.g., 36 CFR 296, 800, and the PA with the Virginia SHPO) and occurs on a case-by-case basis separate from alternatives. Therefore, effects to heritage resources resulting from minerals management are not affected by alternative.

Individual and multiple structures located on the Jefferson National Forest that are determined to be historically significant are protected and maintained under the terms and conditions of existing federal laws and guidelines. The construction of new facilities could directly affect an unknown significant prehistoric or historic property. In most cases of concrete slab or footing construction, disturbance may extend into or below soil strata containing archeological deposits. Lighter facilities, such as boardwalks, piers, or structures located on pier foundations, would present less potential for damage although the potential remains. The construction of structures could also directly affect significant heritage resources by introducing a visual effect that conflicts with or diminishes the setting and nature of an historic property. Indirect effects could include erosion or vandalism of significant heritage resources facilitated by public access following construction of structures in the immediate vicinity.

Analysis of effects to significant historic structures and the effects of the construction of structures to heritage resources is performed programmatically in compliance with existing laws and regulations (e.g., 36 CFR 296, 800, and the PA with the Virginia SHPO) and occurs apart from alternatives. As such, effects to heritage resources resulting from land exchange from federal jurisdiction is not affected by alternative

Cumulative Effects

Apart from these common effects, potential maximum direct, indirect and cumulative effects to heritage resources of the approximately 723,300 that compose the Jefferson National Forest can be assessed according to the maximum extent (acres) within which ground-disturbing activities can potentially occur for each alternative. The principal proposed ground-disturbing activities include: timber, recreation and fire management. The acreage within which potentially ground disturbance, and concomitant effects to heritage resources, can occur is presented by alternative in Table 3-149. Direct ground disturbing effects range from 966 acres in Alternative G (0.13% of the Forest) to 2,329 acres in Alternative D (0.32% of the Forest) for the first decade. In other words annual disturbance is estimated to be 1/10 of these figures.

Cumulatively, the repeated implementation of these project activities could, over time, result in the degradation of sites, a potential reduction in the number of intact historic properties, and increased site vandalism. However, the standards common to all alternatives are designed to inventory, evaluate, and preserve significant heritage resource values through avoiding, minimizing, or mitigating negative effects of these management activities.

MOUNT ROGERS NATIONAL RECREATION AREA

The Mount Rogers National Recreation Area (NRA) was designated on May 31, 1966. The Mount Rogers NRA Final Management Plan and Environmental Impact Statement were issued on March 13, 1980. According to the Act of 1966, the Mount Rogers NRA was established "In order to provide for the public outdoor recreation use and enjoyment of the area in the vicinity of Mount Rogers, the highest mountain in the State of Virginia, and to the extent feasible the conservation of scenic, scientific, historic, and other values of the area…."

The NRA provides a wide range of recreation opportunities from highly developed sites to remote wilderness and backcountry, including three congressionally designated wildernesses (Lewis Fork, Little Wilson, and Little Dry Run). The area maintains over 300 miles of system trails, including the Appalachian National Scenic Trail, the Virginia Highlands Horse Trail, the Iron Mountain Trail, and the Virginia Creeper Trail. The Feathercamp and Panther Knob areas of the NRA contain the only motorized backcountry recreation opportunities in the Southern Appalachians.

Two prominent peaks, Mount Rogers and Whitetop Mountain, are the highest point and the highest motor road in Virginia respectively. These two areas make up the Mount Rogers High Country. The open high elevation balds in these areas contain spectacular scenery, heavy recreation use, and sensitive rare communities. On July 27, 1999, the Mount Rogers NRA began a nine-step planning process for the Mount Rogers High Country called Limits of Acceptable Change (LAC). The main purpose of LAC is to manage recreational use and impacts. The nine-step process consists of a series of public meetings to capture ideas and help formulate a plan for the long-term management of the High Country. Although the LAC process is not completed, standards and goals for recreational use in the High Country completed to date have been considered in this Forest Plan revision process.

The high elevations of Mount Rogers NRA comprise one of the most diverse assemblages of flora and fauna in Virginia that ranks very high throughout North America. The Virginia Division of Natural Heritage states that it also "contains one of the greatest concentrations of rare species and significant associates of plant communities in the state." Biologists believe the healthiest population of the Federally Endangered Northern flying squirrel in the state is located within this area. It is the northern limit of range for such species as Fraser fir, Umbrella leaf, Weller's salamander, Pigmy salamander, and Shovel-nosed salamander. Forest communities such as Red spruce, Red spruce/Fraser fir, Red spruce/Northern hardwood forest, Sub-alpine Beech Orchard, and Mountaintop bald found within this special area are also very rare in Virginia. Whitetop Mountain supports the best representative stand of Red spruce in Virginia that is more than 150 years old. Rare forest plants such as globally-rare Mountain bittercress, and the state-rare Slender wood reedgrass, Fringed scorpion-weed, Great Indian-plantain, Blue Ridge St. John's wort, Roan Mountain rattlesnake-root and the state-rare Long-stalked holly also occur here. There is also a significant but unusual community of dwarfed northern hardwoods (submesotrophic scrub) on Whitetop Mountain.

More information on the rare communities and species of the Mount Rogers NRA can be found in the rare communities and wildlife sections of this Chapter.

The vegetation composition of the High Country has changed dramatically over the last 100 years. In the early 1900's, the area around Mount Rogers was northern hardwoods and Red spruce/Fraser fir. Widespread logging, human-caused fires, and grazing converted the forest into an open pasture area. The Forest Service completed acquisition of the high elevation areas in the early 1970's. Over 2,000 acres are maintained in an open grassy condition through a variety of management actions. These include cattle and pony grazing, limited herbicide use, prescribed fire, and mechanical cutting. A variety of native grasses, sedges and forbs are maintained throughout the balds.

The Whitetop area is the primary source for the collection of Sugar maple sap and wild leeks (ramps) that support local festival fund raising events for nearby fire departments and life saving crews. Such festivals are growing in numbers of participating visitors. Thus, there is an increasing demand for these products each year.

Direct and Indirect Effects

When citizens were asked what concerns or needs for change they had regarding management of the Mount Rogers NRA, all agreed that the mix of goods and services on the NRA needs to be commensurate with the qualities of the area that established its special designation as a National Recreation Area. They also had concerns about timber harvest, roads, land acquisition, recreation development, economic development including tourism, trail use and management of the High Country. There was controversy regarding the use of livestock grazing, prescribed fire and ponies in the High Country and whether these areas should continue to be maintained as open or allowed to revert to forested cover. The various alternatives considered in detail explored these differences.

Table 3-150 displays the mix of management prescriptions used for the various alternatives. This provides a snapshot of how each alternative addressed the issues surrounding management of the Mount Rogers NRA differently. The NRA was discussed

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Table 3-150. Mix of Management Prescriptions on the Mount Rogers NRA by Alternative (thousands of acres)

Prescription Code	Alternative A	B	D	E	G	I
0B	0.5	0.5	0.5	0.5		0.5
1A	12.3	12.3	12.3	12.3	12.3	12.3
1B	4.7	2.0	0.2	15.5	22.6	2.1
2C3	4.0			1.2	1.5	1.2
4A	11.8	13.7	14.7	11.7	11.6	6.4
4B2		0.4			0.4	
4C1	0.9		0.8	0.8		0.8
4D	0.5	0.5	0.5	0.5	0.5	0.5
4E1a	<0.1	<0.1	<0.1	<0.1	<0.1	<0.1
4F	4.4	0.6	0.6	6.9		0.1
4K						14.2
5A	<0.1	<0.1	<0.1	<0.1	<0.1	<0.1
5B						<0.1
5.C						0.1
6A	0.6	1.0	0.4	0.6	2.9	0.2
6B	0.4	0.1	0.1	0.5	1.9	0.2
6C	1.8	22.4	4.7	5.1	33.7	3.3
7A	1.9		0.5	1.6		1.8
7B	38.8		1.4	36.6		11.5
7D	6.2	3.2	3.3	11.1	2.3	2.6
7E1	1.9			3.9		3.4
7E2	10.9		24.4	4.4		23.3
7G	6.3	0.6		3.6		3.6
8A1		23.0	2.5		0.1	7.1
8A2	3.7	2.3			15.2	
8C	2.2	8.5			7.9	20.4
8E1	2.5			1.8		2.2
8E5	<0.1	0.1	0.1	<0.1	0.1	
8E6		2.4			2.1	
9A1	4.8	4.8	4.8	4.8	4.8	
9A3	0.3	7.4	0.3	0.3	1.5	0.6
9B2		1.0				
9B3		7.4	8.9		10.7	
9F		1.1			1.1	
9H		23.0	4.7		0.1	3.3
10A			31.2			
10B	7.9		19.5	1.9		
10D			4.4			
12A				6.1	7.3	7.4
12B	11.5	2.5		9.1	0.2	11.7
Total	140.8	140.8	140.8	140.8	140.8	140.8

separately all through the planning process. It was treated slightly differently from the remainder of the Forest in each alternative. The following paragraphs describe these different management philosophies for the NRA under each alternative.

Alternative A

Alternative A is closest to the 1980 NRA Plan and addresses concerns from local citizens who had high expectations for increased recreation and tourism money to the local economy. The objectives of the 1980 NRA Plan are revised to take into account budget and a more natural appearing emphasis. Forest Plan goals would encourage festivals, fairs, and outfitters/guides.

The high scenic quality of the open balds would be maintained, resulting in increased grazing. New tourism opportunities like a possible railroad restoration for tourist excursions and the Mount Rogers Scenic Byway would be explored. The NRA would be highlighted as a regional destination. Management prescription 7B (Scenic Viewsheds and Corridors) would be the predominant prescription. High quality sawtimber would be emphasized in Site Index 70 and better areas, providing not only valuable wood products, but large, aesthetically pleasing trees as well.

The current motorized trail system would be maintained and opportunities for expansion of this use would be explored. Additions to Lewis Fork, Little Wilson, and Little Dry Run Wildernesses would be recommended. Beaverdam Creek and Whitetop Laurel Creek would be highlighted as eligible Wild and Scenic Rivers. Whitetop and Chestnut Mountains would be managed as Scenic Areas. Seng Mountain and Little Horse Heaven would be managed as backcountry recreation areas with few open roads, providing for continuing backcountry motorized and mountain bike uses of these areas.

Alternative B

Alternative B focuses on the ecological significance of the NRA with greater controls and regulation of dispersed recreation users. All open areas in the High Country would be restored to high elevation spruce-fir and northern hardwoods to benefit northern flying squirrel and Fraser fir; however, the Whitetop and Elk Garden balds would continue to be maintained.

Maintenance and Restoration of Forest Communities (9H), Mix of Successional Habitats (8A1), and Old Growth (6A, 6B, and 6C) are the primary management prescriptions used under this alternative, which is similar to the rest of the Forest. Scenery is protected through the Scenery Management System with much of the area managed for a high scenic integrity objective. Motorized trails and livestock grazing would be phased out over time with any problem areas being closed as soon as feasible. Seng Mountain and Raccoon Branch would be managed as backcountry recreation areas. Additions to the Lewis Fork and Little Wilson Wildernesses would be recommended.

Alternative D

Under Alternative D, the objectives of the 1980 NRA Plan are revised to take into account budget and a more natural appearing emphasis. There would be a slight increase in motorized access, but otherwise, there would be no significant changes in developed and dispersed recreation facilities and opportunities.

Alternative D would take advantage of the highly productive sites of the Mount Rogers NRA to produce high quality sawtimber valuable not only as flooring and furniture, but as

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aesthetically pleasing trees as well. A mixture of timber and recreation emphasis prescriptions are the primary land allocations under Alternative D. Scenery is protected through the Scenery Management System with much of the area managed for a high scenic integrity objective. Northern hardwoods, spruce, and fir forest communities would be managed to maintain and restore a diversity of age classes using research science and silviculture. High elevation balds and open areas important for species viability, scenery and recreation would be maintained. No wilderness study areas would be recommended. Whitetop Laurel would be managed as a Scenic Area.

Alternative E

Alternative E emphasizes and increases backcountry, remote experiences. Seng Mountain and Raccoon Branch would be recommended as stand-alone wilderness study areas, as well as wilderness additions to Lewis Fork, Little Wilson, and Little Dry Run Wildernesses. Whitetop Mountain and Whitetop Laurel would be managed as a Scenic Area and Beaverdam Creek as an eligible Wild and Scenic River. Ewing Mountain, Little Horse Heaven, and Feathercamp would be managed as backcountry recreation areas with continuation of the backcountry motorized and non-motorized road and trail uses in these areas. Existing motorized trail use would continue in the Feathercamp area only. Livestock grazing would continue at reduced levels to maintain open areas in the High Country outside of recommended wilderness and at increased levels along major travelways to provide pastoral settings.

Scenery, recreation, and wilderness management prescriptions predominate. A full range of management tools is available for managing or expanding open areas and addressing user impacts and resource problems in the High Country. A moderate increase in developed recreation facilities would be planned primarily on the east end of the NRA to alleviate recreation pressure on the west end. However, the main emphasis would be on a raising the developmental level of existing recreation areas. Tourism is promoted and the NRA is highlighted as a regional destination.

Alternative F

Alternative F provides the current level and degree of management. The existing NRA Plan would be incorporated into the revised Forest Plan with adjustments to reflect current budgets. New developed recreation facilities planned under the 1980 Plan and not yet constructed would not be carried forward. No new wilderness study areas would be recommended. Backcountry areas would exist with existing semi-primitive motorized and non-motorized areas, but would not be enlarged to include inventoried roadless areas. Existing motorized trail use would continue. Livestock grazing would continue at current levels to maintain open areas in the High Country and provide pastoral settings along major travelways.

Alternative G

Alternative G allows recreation and other resource management when compatible with biological/ecological needs. All open areas in the High Country would not be actively managed or manipulated. The emphasis would be on semi-primitive recreation with a corresponding reduction in motorized use. Scenery management focuses on natural appearing/natural evolving landscapes, particularly at the higher elevations. Whitetop road and electronics site are closed and rehabilitated.

Wilderness, old growth, and Area-Sensitive Mid- to Late-Successional Forest Habitats (8A2) are the primary land allocations. All inventoried roadless areas and wilderness additions are recommended for wilderness study. Mountain bike and motorized trail uses are discontinued in Seng Mountain, Raccoon Branch, and Little Dry Run addition. The Virginia Highlands Horse Trail would be relocated to avoid recommended wilderness areas. Whitetop Laurel is highlighted as an eligible Wild and Scenic River. Ewing Mountain is managed as backcountry recreation.

Alternative I

Alternative I maintains the diversity of recreation opportunities and scenic qualities of the Mount Rogers NRA, while increasing backcountry experiences and protecting important biological and ecological resources and values. A full range of management tools is available for managing the open areas of the High Country and addressing user impacts and resource problems. Key habitat areas for the northern flying squirrel are restored to northern hardwood and spruce-fir forest. A moderate increase in developed recreation facilities is planned, emphasizing raising the developmental level of existing facilities.

Primary land allocations are split between recreation, special areas, wilderness, backcountry, and scenery. Little Wilson Wilderness Addition would be recommended as wilderness study as well as two additional areas, Helton Creek and Stone Mountain Branch, additions to Lewis Fork and Little Wilson respectively. Whitetop Mountain, Mount Rogers, and Whitetop Laurel are managed as Special Areas, which recognize their importance as both recreation destinations and important ecological resources. Beaverdam Creek is highlighted as an eligible Wild and Scenic River.

The backcountry motorized trail experiences in Feathercamp and Little Dry Run continue, but are not expanded. The cores of Seng Mountain, Raccoon Branch, and Little Horse Heaven are managed as backcountry areas that maintain these values along with the existing equestrian and mountain bike trail use. The remainder of Seng Mountain is managed for black bear by providing important remote early successional habitat and maintaining existing backcountry hunting opportunities.

Cumulative Effects

Each issue considered for the entire Forest was also considered separately in light of the designating Act for the NRA, therefore cumulative effects by resource area are discussed in other sections of this document.

SCENERY

The Jefferson National Forest extends 220 miles in length and covers about ¾ million acres of the picturesque mountains and valleys of southwest Virginia and southeast West Virginia. About 88% of the Forest can be seen from adjacent or interior roads, trails or waterways, largely due to the mountainous terrain. About 12% is seldom seen. Steeped in the American traditions of the Great Valley of Virginia and the Allegheny and Blue Ridge Mountains, the Forest has been a travelway for Native Americans, a passageway for pioneers, and the setting of Civil War battles. Remnants of these original travelways are still visible but most have been converted to paved state and interstate highways, scenic drives and trails such as the Blue Ridge Parkway and Appalachian National Scenic Trail, providing visitors high visibility of Forest lands. Historic elements of the Civil War Era such as old iron furnaces, canal systems, railways and early settlement log and brick structures dot the landscape. Many small rural communities and larger cities are afforded beautiful mountain backdrops. Throughout historic times, and no doubt in prehistoric times as well, people have and continue to enjoy the beauty of this attractive mix of forested and rural agricultural lands.

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SCENERY

The valleys are pierced with numerous clear, bubbling streams, cascades and major rivers such as the Roanoke, James and New Rivers. The New River is claimed to be the oldest river in the Americas and the second oldest in the world. Manmade lakes and ponds often visited by domestic livestock and wildlife add dynamic beauty to the landscape.

The scenic resources on all areas of the Forest, benefit from the four distinct seasons displayed in its mix of hardwoods and pines – the spring blossoms of understory trees, the rich full greens of summer, the fiery reds and ambers of fall, and the serenity of winter.

The more scenic landscapes (those in Retention and Partial Retention VMS or in High or Moderate SMS) are generally associated with, or occur adjacent to, lakes, rivers and streams, or highly developed recreation areas, the Appalachian National Scenic Trail and the Blue Ridge Parkway. Elevations in the Jefferson National Forest range from high points over 5,500 feet on the Mount Rogers National Recreation Area to lower elevations of less than 1,000 feet along some rivers and streams. Views beyond the immediate foreground are influenced by terrain as well as vegetation type and density. The steep to rolling ridges and valleys characterizing the forest are covered with an almost-continuous canopy of soft to medium-textured rounded tree forms, creating a natural-appearing landscape character dotted with cultural character enclaves. Since the late 1990's, as a result of the gypsy moth and hemlock woolly adelgid infestation that killed large numbers of native oaks and hemlock, part of the canopy has opened. Groups of tall, gray, defoliated stems, varying in size from less than an acre to more than 25 acres, eventually give way to an emerging deciduous and evergreen understory. This process is speeded by active salvage operations in areas where human health and safety is critical.

Landscape Themes and Existing Landscape Character

Of the seven Land Use Themes described in the Southern Appalachian Assessment, Jefferson National Forest landscapes can be grouped predominantly into four: Natural Evolving, Natural Appearing, Rural-Forested and Rural–Pastoral/Agricultural (SAA, p1-33). Small enclaves of historic character are embedded within the larger land use theme areas.

- The vast majority of the Forest, more than 556,000 acres (78%), is characterized as Natural Appearing.
- Designated Wilderness (57,800 acres) and other roadless areas (89,000 acres) (totally 20%), lands where ecological processes predominate, are characteristically Natural Evolving landscapes.
- Rural-Forested is a very small category that includes the Forest's most highly developed recreation areas, about 7,500 acres (1%).
- Rural-Pastoral/Agricultural and other open areas, about 8,200 acres (1%), is a limited but highly valued category composed mainly of areas in the high country and lower valleys of the Mount Rogers NRA, and scattered areas of the Glenwood, New Castle, New River Valley Ranger Districts and some managed open areas along the Appalachian Trail.

Landscape character is an overall visual and cultural impression of landscape attributes – the physical appearance and cultural context of a landscape that gives it an identity and 'sense of place'. The landscape character and its attributes are the basis for the Scenery Management System's scenic inventory. Landscape character is based upon the ecological section the inventoried lands are within. The Jefferson National Forest is located within Ridge and Valley, Blue Ridge Mountains, and Cumberland Plateaus ecological sections as described by Bailey and others (1994).

Ridge and Valley Section occurs in the Forest's New Castle, New River Valley and Clinch Ranger Districts and a very small portion of the Glenwood Ranger District, west of the Blue Ridge Mountains Section. The picturesque Great Valley of Virginia lies within this section. Elevation ranges from 500 to 4,000 feet, with parallel landforms characterized by narrow valleys and high ridges. Precipitation ranges from 30-45 inches annually, with mixed vegetation of appalachian oak and oak/hickory/pine components. The valleys typically exhibit rural Americana private pastoral landscape character with a mix of recent and historic structures. Tourists enjoy nostalgic drives through these settings that are afforded forest covered mountain backdrops.

Blue Ridge Mountains Section runs down the eastern boundary of the Jefferson National Forest. It dominates the Glenwood District and Mount Rogers NRA. Elevation ranges from 1,000 to 6,000 feet: the majority (80%) of this section is characterized by low mountains, but several high peaks occur in the 5-6,000+ elevations. One-fifth of the section is characterized by open, low mountains. Precipitation ranges from 40-50 inches annually, with mixed vegetation of appalachian oak, southeastern spruce fir and northern hardwood components. The nationally acclaimed scenic Blue Ridge Parkway and Appalachian National Scenic Trail traverse the ridge tops of this section. They provide millions of tourist visits annually with extremely high concentrations of use during the fall color season.

Cumberland Plateaus Section classifies lands in the western portion of the Clinch Ranger District west of the Ridge and Valley Section. Elevation ranges from 1,000 to 4,500 feet. Local relief generally ranges from 1,000 to 2,500 feet. The surface is generally characterized by narrow winding ridges, steep valley walls with rock cliffs, and narrow bottoms. Low broad ridges or swells are common. Vegetation is predominantly deciduous trees, mainly oaks, yellow poplar and hickories. Virginia, shortleaf and pitch pine are common near cliffs and on the narrow ridge tops. Precipitation averages 45 to 60 inches per year; about 20 to 30 percent of this is snow. Agricultural pastures and hay meadows are common on river and stream flood plains and on limestone soils. Tourism is a growing industry and recreation use is relatively light but extensive. Settlements are small and dispersed. Timber production, strip-mining for coal and natural gas production are major industries in areas adjacent to the Forest. On ground views of mountain slopes offer visitors a feeling of a natural appearing landscape and rural residential and industrial settings along many of the travelways located on the narrow ridges and in the narrow valleys. Aerial views of non-federal lands near the Forest often appear dominated by heavily modified industrial landscapes and reclamation areas.

Existing Visual Quality

The scenic resources of the Jefferson National Forest are currently managed in accordance with the 1985 Land and Resources Management Plan, as amended. Scenic resource management direction in the Forest Plan is through Visual Quality Objectives (VQOs), determined by the Visual Management System (VMS). All Jefferson NFS lands have been re-inventoried to comply with the Scenery Management System (SMS), which replaced the VMS in 1995. Table 3-151 indicates the current scenic condition of NFS lands under current management.

Generally all six categories are dispersed throughout the Forest. Wilderness Areas fall within the "Preservation" VQO. Developed recreation areas and the lands seen from them and Interstate Highways, major roadways, scenic watercourses, the Blue Ridge Parkway, Appalachian Trail, National Recreation Trails and other major trails fall within "Retention" and "Partial Retention" VQOs. Lands classified as "Modification" and "Maximum Modification" are usually located along or seen from local low traffic volume travelways or are found in seldom-seen backcountry areas. Areas currently inventoried as "Unacceptable Modification" represent types of land use activities that historically have difficulty harmonizing with a predominantly natural appearing setting such as utility corridors, communication sites and surface mineral extraction areas.

Table 3-151. Current Scenic Condition Resulting from Current Direction

Visual Quality Objectives	Thousands of Acres	% of Landbase
Preservation	22	3%
Retention	482	67%
Partial Retention	144	20%
Modification	55	7%
Maximum Modification	3	0.5%
Unacceptable Modification	17	2%
Total	**723**	**100%**

For Forest Plan Revision purposes, Scenic Integrity Objectives (SIOs) were established for each management prescription using the Scenery Management System. These range from *Very High* (VH: unaltered) to *Low* (L: moderately altered). *Very Low* is not a scenery management objective in this analysis, however an equivalent VQO of *Maximum Modification* was in the VMS and in the previous Forest Plan. The SIOs define the different levels of acceptable potential alteration to the Forest's scenery, by management prescription.

The crosswalk between Visual Quality Objectives (Visual Management System) and Scenic Integrity Objectives (the updated Scenery Management System) is shown in Table 3-152.

Table 3-152. Comparison of VMS and SMS*

Visual Quality Objective (VQO)	Appearance To Casual Observer	Scenic Integrity Objective (SIO)
Preservation (P)	Unaltered	Very High (VH)
Retention (R)	Appears Unaltered	High (H)
Partial Retention (PR)	Slightly Altered	Moderate (M)
Modification (M)	Moderately Altered	Low (L)
Maximum Modification (MM)	Heavily Altered	Very Low (VL)

* See Landscape Aesthetics, A Handbook for Scenery Management, Agricultural Handbook Number 701 for description of the SMS system and cross-walk between the SMS-SIOs and the VMS-VQOs. National Forests lands have been inventoried to identify Scenic Classes from 1 (highest level) to 6.

Special places

Special Places are those specific locations and expanses in outdoor settings that have attractions and features that are identified as unique, different, distinctive, and extraordinary to people. Special places may range from small areas, such as a particular 'swimming hole', to large areas, such as an entire river gorge. Special Places may be, but are not necessarily components of the Forest's designated "Special Areas."

A comprehensive inventory of constituents' and agency identified special places has been and will continue to be compiled. Scenery Inventory, constituents' comments to project analysis, and in-service project analysis will serve as the main sources of future special place designations. Table 3-153 displays the categories and numbers of sites that been inventoried.

Table 3-153. Number of Special Places by Ranger District

Ranger District	Natural Place	Cultural Place	Cultural / Natural Place	TOTAL
Glenwood	11	2	1	14
New Castle	11	7	1	19
New River Valley	23	3	1	27
Mount Rogers NRA	54	12	2	68
Clinch	17	1	5	23
TOTAL	116	25	10	151

Most of the sites fall within boundaries of designated Wilderness, developed recreation areas, areas established as thematic cultural landscapes or rural historic districts or fall within corridors of scenic byways, rivers, and nationally-designated trails. All of these fall within areas with established Visual Management Objectives (Scenic Integrity Objectives), by management Prescription.

Direct, Indirect, and Cumulative Effects

The scenic resource is affected by management activities altering the appearance of what is seen in the landscape. Short-term scenic effects are usually considered in terms of degree of visual contrast with existing or adjacent conditions that result from management activity. The scenic landscape can be changed over the long-term or cumulatively by the alteration of the visual character. Management activities, which result in visual alterations inconsistent with the assigned SIO, even with mitigation, affect scenery. Management activities that have the greatest potential of affecting scenery are road construction, vegetation management, insect and disease control, special use utility rights-of-ways, and mineral extraction. Other management activities that also can affect the scenic resource at a lesser degree are threatened and endangered (T&E) species habitat management, prescribed burning, fire suppression, land exchange, old growth forest management, recreation, administrative site facility construction, and wildlife management. See Table 3-154 and Table 155 for SIO allocation by alternative.

Table 3-154. SIO Acres by Alternative (thousands of acres)

	Alternative						
SIO	**A**	**B**	**D**	**E**	**F***	**G**	**I**
Very High	90	84	79	145	58	231	100
High	294	299	250	385	58	251	283
Moderate	269	237	259	176	195	186	242
Low	70	103	135	17	354	55	98
Very Low					58		
TOTAL	**723**	**723**	**723**	**723**	**723**	**723**	**723**

* 1985 Forest Plan

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Table 3-155. SIO by Alternative Expressed as Percent of Total Forest Acres

	Alternative						
SIO	**A**	**B**	**D**	**E**	**F***	**G**	**I**
Very High	12%	12%	11%	20%	8%	32%	14%
High	37%	39%	29%	53%	8%	34%	38%
Moderate	41%	34%	40%	25%	27%	26%	34%
Low	10%	15%	20%	2%	49%	8%	14%
Very Low	0	0	0	0	8%	0	0
TOTAL	**100%**	**100%**	**100%**	**100%**	**100%**	**100%**	**100%**

* 1985 Forest Plan

All eleven existing designated Wilderness areas are consistently allocated to a Very High SIO in all alternatives. All areas within the Recommended Wilderness Study prescription, the Recommended or Eligible Wild River prescription for Roaring Branch and Peaks of Otter Salamander Primary Habitat Protection Area are also allocated to a Very High SIO. The North Slope of Whitetop Mountain Research Natural Area is proposed under Alternatives B and G together with prescribed Natural Processes in Backcountry Remote areas, and many Existing Old Growth areas such as Flannery Ridge on the Clinch District, are all allocated to a Very High SIO.

Areas that are consistently allocated a High SIO include: Whitetop Laurel, Mount Rogers Crest Zone and Whitetop Mountain special areas; the Appalachian Trail Corridor outside of Wilderness; Raven Cliff karst area; The Boulder Fields near Breaks Interstate Park; Reference Watersheds; Riparian Areas and Rare Communities prescriptive areas such as Glady Fork Beaver Meadow Wetland and Mount Rogers Spruce-Fir Forest; the Big Walker and Mount Rogers Scenic Byway corridors; all 99 developed areas and recreation sites on the Forest.

Some designated communication sites and portions of designated utility corridors consistently have a Low SIO across all alternatives; portions of Round Mountain, Arnold Valley and Wildcat Mountain have Low SIO in Alternatives B and G.

In contrast to Alternative F (the 1985 Forest Plan), all other alternatives result in increases in lands assigned Very High SIOs. Acreage allocations in VH SIOs in Alternative G represent 33% of all Forest lands. Other alternatives range from 26% (E and I) to 20%-21% (A and B) in VH, except Alternatives D and F at 13% and 8%.

Alternative F represents the current scenic management direction under the 1985 Forest Plan with 8% in the High SIO category. Recent inventories indicate that 67% of the Forest lands actually exhibit High scenic integrity. This can be attributed to good professional scenery management in the past and to reductions in the timber harvesting program in recent years. All the action alternatives indicate respectably High SIOs ranging from 26% in Alternative I to 46% in Alternative E. Two alternatives, E and G, each at 26% are below current management direction F at 27% for the Moderate SIO. All of the other alternatives have increases over F for the Moderate SIO. Action alternatives that receive the highest acreage to High and Moderate SIO combined are A and E at 72%. Alternatives D, B, I and G reflect a moderate number at 68%, 66%, 62% and 60% respectively. Alternatives that receive the highest acreage to High and Medium SIOs would result in more protection and enhancement to the scenic resources than alternatives having fewer acres assigned to the higher SIOs. However, those alternatives with more acres assigned to SIOs of H would provide a greater amount of protection and enhancement. In descending order, these are Alternatives E, G, B, A, D and I. Alternatives A, E and G have the least acres assigned to Low SIO. Alternative F has the most and Alternatives D and B the next largest assigned to

Low SIO.

Negative impacts to scenery from road construction, vegetation management, insect and disease control, special use utility rights-of-ways, and mineral extraction would be the greatest in Alternative F (the 1985 Forest Plan alternative) that also includes an SIO of VL (Very Low) on 8% of the total Forest acreage, and a combined total of 412,110 acres (57%) in L, VL. VL is no longer an SIO that will be considered for management in the lower 48 states under the updated Scenery Management System. Alternative D is second with the greatest number of potential negative impacts to scenery, at 19% of the total Forest lands assigned to a Low SIO. Many of these impacts could be avoided or reduced by implementing mitigation measures. Impact would be the lowest in Alternative G because the emphasis is on wilderness, wilderness study areas, remote backcountry recreation and old growth with a decrease in roads and all forms of vegetation management.

Existing designated Wilderness (1A) are lands currently considered Natural Evolving. The acreage (57,800 acres) about 8% of Forest lands, remains the same across all Alternatives. With a greater amount of acreage allocated to Wilderness Study Areas (1B) in Alternatives G (156,100 acres) and E (81,600 acres), there could be a shift from Natural Appearing to Natural Evolving landscape character on approximately 11% to 20% of the Forest. Acreage allocations in Alternatives I and A could allow a shift from Natural Appearing to Natural Evolving on approximately 3% to 4% of the Forest. By grouping acreages allocated to Prescriptions 1A, 1B, 4A, 4F, 4K, the 6s, 9F, 12A and 12B, the potential shift in landscape character into the upper ranges of Natural Appearing to becoming Natural Evolving could range from 21% (Alternative D) to a high of 55% in Alternative G.

All alternatives propose prescribed burning each year ranging from 2,931 acres in Alternative F, the no-action alternative, to 19,342 acres in Alternative B. Drifting smoke and blackened vegetation and charred tree trunks would be the main negative effects to scenery. Visual contrast to the general forest from fire line construction could also be evident. The contrast levels and duration vary with fire frequency and intensity. Smoke may only last one day; blackened vegetation usually lasts a short time, while charring of trees may be evident for many years. Repetitive burning may reduce overall visual diversity: it may result in loss of valued mid-and understory species such as flowering dogwood, but may promote herbaceous flowering species. Prescribed fire repeated over time produces stands with open, or park-like, understories that allow views farther into the forested landscape. Prescribed burning is limited and/or low probability in 14% to 34% of the Forest in each of the Alternatives except the current no-action Alternative F (8%, low likelihood in designated Wilderness). The Alternatives with the most limits are G and E (both at 34%). Alternatives A and I provide limits in approximately 21% and B and D provide limits at approximately 14% of the Forest.

Insect infestations and diseases can cause strong, unattractive contrasts in the landscape. Management efforts to control insect infestations and diseases can minimize or reduce effects. Control efforts that include removal of infected trees and buffer areas often appear as clearcutting to forest visitors. These impacts can occur in areas of high scenic value. There are two infestations of major concern on the Jefferson: Gypsy moth and Southern pine beetle. Control efforts are similar across all Alternatives. The types of control vary with site-specific situations and are sensitive to limiting negative impacts to scenic quality.

Utility rights-of-way (ROWs) possess a high potential for affecting the scenery resource for a long duration. Cleared ROWs and/or utility structures contrast, and may be incongruent, with the surrounding Forest landscape. Cleared ROWs contrast in form, line, color, and texture when compared to the natural appearing landscape. All alternatives prohibit new utility corridors in certain areas (wilderness and wilderness study areas), with Alternatives E and G being the most prohibitive with approximately 40% of the Forest being off limits. In addition to those areas where new corridors are prohibited, all alternatives also restrict development of new corridors to additional management prescriptions, with Alternative G and E being the most restrictive, with restrictions on approximately 81% allow the least amount of structures and openings on the Forest; Alternative A and B with restrictions on 67% and 61% respectively; Alternative D, with restrictions on approximately 45% of the Forest; and Alternative F, being the least restrictive with restrictions on 42% of the Forest.

Though functionally important, the industrial urban character of communication sites can create a sharp contrast to surrounding natural appearing landscapes. Under all alternatives, eleven communication sites will be designated. Of these eleven sites, three of them have not previously been classified as communication sites or designated as such through a previous NEPA decisions. They are Quebec Knob on the Mount Rogers National Recreation Area and High Knob and Mayking Peak on the Clinch District. The Quebec Knob site is new and initially may have two users. Any structures that protrude above the existing canopy at this site have potential visual impacts to users of the Appalachian National Scenic Trail in the middle ground and users of Interstate Highway 81 in a background distance view. The two other sites currently have one and two users respectively and no expansion or additional impacts appear imminent.

Mineral management and development activities can involve major alternation to landform, as well as contrasts to form, line, color, and texture, causing substantially adverse scenic impacts. Coal extraction and drilling for natural gas are common activities on the Clinch Ranger District. The other ranger districts have very limited activity, usually shale pits, limestone extraction and surface building rock collection. Based upon anticipated minerals activities and the resultant impacts from expected new gas well sites, associated roads, pipeline clearing and disturbance to soils, the ranking descending from greatest impacts to least impacts is: Alternatives F has 324 new wells over 20 yrs and 1,530 disturbed acres; B has 284 new wells and 1,335 acres disturbed and D 276 new wells and 1,300 disturbed acres; G, I, E and A drop to 268 wells then down to 263 new wells over 20 yrs and 1,257 acres down to 1,236 disturbed acres.

Road maintenance affects scenery, especially activities to rights-of-way. 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. Alternative F would allow the most road construction and associated maintenance, causing negative visual contrasts; D with ½% less impact than F; A with 18% less; I with 23% less; B with 28% less; E with 38% less and Alternative G has the least impact from all forms of road construction and maintenance with 53% less than Alternative F.

Vegetation management has a great potential to alter the landscape and impact the scenic resource. Timber harvest practices can cause long-term effects on scenery. Species conversion, reduction in species diversity, manipulation of the prominent age class, and alteration of opening size, location, and frequency can alter landscape character. The potential effects may be positive or negative, depending on their consistency with the desired future condition of the landscape.

Of the management applications, even-aged management may be the most impacting. Among the even-aged regeneration methods, clearcutting and seed-tree harvest produces the highest visual contrasts because they remove the most forest canopy and create openings. These openings would vary in their effects on scenery depending on size, shape, location, and nearness to other openings. Openings that repeat the size and general character of surrounding natural openings and the landscape character would have the least impact on scenery. Single-tree selection and group selection harvest are normally less evident because they do not cause large openings in the canopy. Uneven-aged regeneration methods can affect scenery, causing contrasts in form, line, color, and texture from slash production. Impacts resulting from timber harvest can be short-term in areas where vegetation growth is relatively rapid. Allowed vegetation management is the most prevalent in Alternative D and F across approximately 4% of the Forest (31,095 acres and 26,000 acres respectively). Alternatives A and I are both at approximately 3% (20,931 acres and 18,319) of total Forest acres, respectively. Alternative B is at 2% (16,247 acres) of vegetation management. Alternative G with less than 1% is the lowest with only 3,688 acres followed by Alternative E at 1% (10,091 acres).

Site preparation activities affect scenery by exposing soil and killing other vegetation. These effects are generally short-term. Site preparation usually improves the appearance of the harvest area by removing unmerchantable trees and most of the broken stems. Stand improvement work can affect scenery by browning the vegetation and reducing visual variety through elimination of target species. The allocations for prescriptions allowing this type activity are very similar to those described in the Vegetation Management paragraph, above.

Wildlife openings are commonly created and maintained in Jefferson National Forest and help create rural-pastoral effects to an otherwise closed canopy. Prescribed burning and mid-story manipulation are sometimes used as wildlife management practices. These activities can reduce over-story diversity and result in loss of valued scenic resources such as flowering dogwoods. Mid-story removal and prescribed burning can produce stands with open under-stories that allow views into the landscape. Alternative B (6,000 acres annually burned) allows the greatest opportunity to restore or promote woodlands, grasslands, and savannas with positive park-like understories. A, D, G, and I average about 5,000 acres burned annually with E (3,000) and F (the no-action alternative) the least at 140 acres. Wildlife management activities are allowed most commonly in Alternatives D (in over 63% of the total Forest acres), F (59%) and E (55%). Alternatives I, B and A range from 45% to 41%. Alternatives G (20%) and E represent the least amount of manipulation at 14%.

Recreation facilities are deviations to the natural landscape, but Forest Service recreation facilities are usually designed to blend into the landscape without major visual disruption. Alternatives E and A provide an allowance for the greatest recreation development, in approximately 15% of the Forest. Alternative I allow development in approximately 11%, with Alternative F allowing development in 9%. The smallest allowance is in Alternative B (1%), followed by Alternative G (3%) and D (5%).

Designation of wilderness will generally cause positive effects to the scenery resource. Old growth forest character will be created over time. A greater amount of acreage is allocated to Wilderness Study Areas (1B) in Alternatives G (156,100 acres) and E (81,600). Acreage allocations in Alternatives A and I increase Wilderness potential on approximately 4% (28,200 acres and 26,200 acres respectively) of the Forest. Alternatives D and B would increase wilderness by approximately 2% (15,700 acres and 15,600 acres respectively). Under F, wilderness would remain at 57,800 acres. The scenic resource could suffer in some areas of the Forest with the low emphasis on controlling insects and disease in Wilderness.

For the most part, Special Places are not affected across Alternatives. However, the inventory list is not complete and will change over time as more sites are inventoried. The size of the special place area will vary as appropriate to protect the character of each individual area.

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TIMBER MANAGEMENT

Forested Area

The Jefferson National Forest (JNF) includes approximately 723,300 acres of National Forest System land in Virginia, West Virginia, and Kentucky. Of this, approximately 704,100 acres are known to be forested (12,300 acres are unknown). As indicated in Table 3-156, the majority of the land area within each county is forested with a considerable variance in the percentage of national forest land located within each county.

Table 3-156. Percentage of Forested Land and Jefferson National Forest Land in Each County

County	% Forested	% JNF
Bedford, VA	69%	3.9%
Bland, VA	81%	32.5%
Botetourt, VA	79%	19.6%
Carroll, VA	64%	2.4%
Craig, VA	88%	55.0%
Dickenson, VA	94%	3.9%
Giles, VA	82%	27.7%
Grayson, VA	70%	11.7%
Lee, VA	79%	4.1%
Montgomery, VA	67%	7.8%
Pulaski, VA	60%	9.3%
Roanoke, VA	69%	2.0%
Rockbridge, VA	71%	5.5%
Scott, VA	88%	10.1%
Smyth, VA	74%	26.8%
Tazewell, VA	72%	2.9%
Washington, VA	71%	6.2%
Wise, VA	88%	14.0%
Wythe, VA	54%	19.7%
Monroe, WV	67%	6.4%
Letcher, KY	88%	<1%
Pike, KY	84%	<1%

Source: Virginia National Land Cover Data Set, U.S. Geological and U.S. Environmental Protection Agency, 1992&2000, Kentucky 1988 FIA data &1989 West Virginia FIA data.

Forest Land Tentatively Suitable for Timber Production

During forest land and resource management planning, the Forest Service is required to identify lands unsuited for timber production (16 USC 1604(k); 36 CFR 219.14). The initial stage (StageI) identifies land tentatively suitable for timber production. Refer to Appendix B for detailed explanation of the three stages of land suitability determination. Table 3-157 displays lands eliminated in Stage I suitability analysis to determine acres tentatively suitable for timber production.

Table 3-157. Stage I Acres Tentatively Suitable for Timber Production

Classification	Acres
Total National Forest Land	723,300
Non-Forest Land (includes water)	(12,000)
Forest Land	711,300
Forest Land-withdrawn for existing designated wilderness	(57,800)
Forest Land-incapable of producing industrial wood	(3,400)
Forest Land-irreversible damage likely to occur & not restockable	(4,300)
Forest Land-inadequate information	(200)
Tentatively Suitable	645,600

Age Class Distribution

Most of the timber on the Jefferson National Forest is currently in the 60-90 year age class as evidenced by Table 3-158 showing current age class distribution. Table 3-159 displays expected age class distribution in 2030, by alternative, following 30 years of plan implementation.

As Table 3-159 indicates in 30 years, the majority of the forested acres in each alternative will be in stands with a stand age greater than 100 years. Projected levels of timber harvesting to create early, sapling/pole, and mid seral stage habitats in any alternative will not offset this further “aging” of the Forest. Alternatives E and G will have the highest percentage of stands 100 years and older with 72%. Alternatives A, B, F, and I are grouped at about 67%, and Alterative D is the lowest at 60%. Conversely, Alternative D will have the greatest percentage of habitats less than forty years of age with 16%. Alternatives A, B, and F are grouped at about 9%. Alternative I is 7% followed by Alternatives E and G at 2%. Age class 41-80 is virtually the same in all alternatives at about 9%, and age class 81-100 is virtually the same in all alternatives at about 15%.

Table 3-158. Current Age Class Distribution

Age Class	2000
0-10	1%
11-20	3%
21-30	3%
31-40	3%
41-50	1%
51-60	3%
61-70	12%
71-80	24%
81-90	21%
91-100	10%
101-110	4%
111-120	5%
121-130	6%
131-140	2%
141-150	1%
151+	1%

Table 3-159. Expected Age Class Distribution by Alternative in 2030

Alternative	0-10	11-40	41-80	81-100	101-130	131-150	150+
A	3%	6%	9%	15%	52%	8%	7%
B	3%	5%	9%	16%	52%	8%	7%
D	6%	10%	9%	15%	46%	7%	7%
E	<1%	2%	10%	16%	55%	9%	8%
F	3%	7%	9%	15%	51%	8%	7%
G	<1%	2%	10%	16%	55%	9%	8%
I	2%	5%	10%	16%	49%	9%	9%
With no harvest	0%	1%	10%	16%	56%	10%	9%
Current Age Class (2000)	1%	9%	40%	31%	15%	3%	1%

Community Types

As the forest ages, it will experience increasing insect and disease problems. The Gypsy Moth will continue its march south and will be more of a factor on the top half of the Forest in the next planning period. Large amounts of mortality are expected in the three oak-associated communities types of Dry Mesic Oak, Dry and Xeric Oak, and Dry and Dry-Mesic Oak Pine. These community types comprise 38%, 17%, and 21%, of the total forested acreage, respectively (Table 3-160). With these three oak-associated community types comprising about 76% of the total forested acreage, substantial periodic gypsy moth defoliations along with subsequent mortality is anticipated. No community type conversions were modeled in the plan. No reliable methodology is currently available to quantify the specific extent of future natural type conversions due to natural forest succession and/or gypsy moth mortality.

Table 3-160. Current Acres of Major Forest Community Types

Community Type	Acres	% of Total
Northern Hardwood	16,800	2%
Conifer- Northern Hardwood	21,300	3%
Mixed Mesophytic	84,000	12%
River Floodplain	300	<1%
Dry Mesic Oak	269,100	38%
Dry and Xeric Oak	120,300	17%
Xeric Pine and Pine-Oak	41,500	6%
Dry and Dry Mesic Oak-Pine	146,700	21%
Montane Spruce Fir	4,100	1%
TOTAL	704,100	100%

Salvage operations will be increasing as we attempt to salvage the dying trees prior to the oak losing their capability to stump sprout and regenerate the next stand to a desirable oak component to meet desired future conditions.

An expanding forest products industry will provide the necessary markets to enable appropriate levels of timber harvesting to provide for vegetative manipulation to meet the desired future conditions of various management prescriptions.

Forest Service Historic Importance

The Southern Appalachian Assessment (SAA, 1996) indicates that the USDA Forest Service is the area's largest single landholder. Thus, the action of the region's national forests can hold more sway over markets than those of any other single landowner. The supply behavior of the public sector is, however, exceedingly difficult to predict. Timber supply from the national forests is governed by laws, agency policy and regulations and a management approach that addresses multiple uses as well as ecological conditions (SAA.1996.Rpt 4-113).

The Southern Appalachian Assessment (SAA) indicates that the pattern of timber production from the national forests has changed considerably. Between 1977 and 1994, the national forests in the SAA averaged 183 million board feet per year. Sales were the lowest in the late 1970's, when they ranged from 130 to 140 million board feet. Production climbed steadily in the mid-1980's, peaking at about 225 million board feet. Since 1985, the 3-year moving average declined to 172 million board feet in 1994. The actual timber sale volume in 1994 was 151 million board feet. For the years 1983, 1986, 1989, and 1992, the national forests provided between 10-12 percent of total production in the SAA. Since national forests have 17 percent of the timberland, their share of total production reflects a less intensive management approach than on private land (SAA, 1996 Rpt 4:122).

In 1994, SAA national forests sold 150 million board feet of timber in the region, 37 percent less than the 239 million board feet sold in 1989. While these declines are mild in comparison to declines observed in the Western United Sates, they represent an important shift in production from the SAA region (SAA, 1996 Rpt 4:113).

In addition, the national forests and their timber production are unevenly distributed across the Southern Appalachians. By comparing timber product output (TPO) records by counties with production from ranger districts, the calculated product shares for each ranger district for years 1983, 1986, 1989, and 1992 was determined. While the Forest Service produced 10-12 percent of the total timber production in the SAA, there was a wide range among districts as displayed in Table 3-161 (SAA, 1996 Rpt 4:124).

Table 3-161. Share of County Timber Produced by Ranger District in SAA

Districts	Share
Tusquitee	53%
Cheoah, Highlands, Wayah	42%
Mt. Rogers / Wythe (NRV)	**39%**
Unaka, Watauga	33%
Brasstown, Cestatee, Tallulah, Toccoa, Cohutta	32%
Blacksburg (NRV), New Castle, Glenwood	**25%**
Lee	24%
Hiawassee, Tellico, Ocoee	24%
Nolichucky	22%
Deerfield, Dry River, James River, Pedlar, Warm Springs	20%
French Board, Pisgah	19%
Clinch	**17%**
Grandfather, Toecane	14%
Shoal Creek, Talladega	13%
Chattooga	12%
Andrew Pickens	7%
Armuchee	5%

Source: SAA.1996. Rpt 4:124

Historical JNF Timber Volumes Sold

Since 1994, national forest timber production has declined drastically in the SAA and on the JNF as well. The following Table 3-162 displays total sold volume in million board feet (MMBF) and converted to million cubic feet (MMCF) on the Jefferson National Forest from the first complete year of plan implementation (1987) through FY 2001.

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Table 3-162. Total Volume Sold on the Jefferson National Forest

Fiscal Year	MMBF (million board feet)	MMCF (million cubic feet)
1987	20.5	2.98
1988	31.6	4.64
1989	31.7	4.64
1990	23.7	3.51
1991	23.6	3.58
1992	17.1	2.50
1993	32.4	4.95
1994	21.4	3.27
1995	9.5	1.45
1996	12.1	2.21
1997	9.2	1.67
1998	9.0	1.63
1999	11.5	2.09
2000	6.4	1.16
2001	11.0	2.01

Source: Annual Cut & Sold Reports. For FYs 1987-1995 board feet per cubic foot conversion was approximately 6.8. In FY 1996, the standard conversion of 5.5 board feet per cubic foot was implemented Region-wide.

Historical JNF Harvest Methods

During the period from 1987-2001, the harvest cutting methods by acres displayed in Table 3-163 were utilized to implement the timber management program objectives from the first complete year of plan implementation.

Table 3-163. Acres by Harvest Cutting Method for Harvested Volume by Fiscal Year

Fiscal Year	Clearcut	Shelter-wood	Group Selection	Thinning	Salvage	Total	Harvest Volume
	(Acres)						(MMBF)
1987	1,870	0	68	560	0	2,498	25.6
1988	2,301	107	13	342	182	2,945	28.7
1989	1,496	62	26	266	0	1,850	21.2
1990	1,210	18	169	209	291	1,897	28.9
1991	1,225	16	157	535	766	2,699	32.5
1992	902	117	210	745	49	2,023	19.1
1993	723	299	175	790	410	2,397	25.4
1994	716	412	191	774	345	2,430	20.1
1995	446	342	139	582	206	1,715	22.3
1996	173	378	207	200	260	1,218	14.5
1997	48	485	825	232	92	1,682	7.7
1998	25	456	120	684	8	1,293	9.5
1999	24	615	155	135	13	942	12.3
2000	0	516	125	473	1	1,115	8.0
2001	38	234	69	278	176	795	5.9

Source: Annual Monitoring Reports, Annual Cut and Sold Reports; Prior to FY 96 volumes were sold and reported in MBFs. Starting in 1996, volumes were sold in CCFs and converted to MBF using the standard R-8 conversion of 5.5 board feet per cubic foot.

As Table 3-163 displays, there has been a steady decline in total acres harvested on the JNF since 1995. A steady decline in the total acres harvested by clearcutting has occurred since 1992. Clearcutting acres have been less than five percent of total annual harvested acres for the last five years.

Forest Service Timber Inventory

Forests are dynamic. They respond to environmental and biological factors that influence growth and mortality as well as to people's uses of forest resources. The combined effects ultimately determine timber inventories. To examine the net effects of these factors, the SAA reported changes in timber inventories over the latest inventory cycles. These estimates generally reflect patterns of growth, removals, and mortality observed in the late 1980's (SAA, 1996 Rpt 4:108).

The ratio of average annual timber removals can be instructive. As a rule, short rotations yield high removal-to-inventory ratios and long rotations yield low ratios. Thus, higher ratios would be expected on private than on national forest land. For the SAA region as a whole, 1.62 percent of the growing-stock volume was removed per year. The rate was 1.76 percent on private land and 1.19 percent on public land. Private rates were greater than public rates in all SAA subregions. The production intensity increased moving from north to south (SAA, 1996 Rpt 4:109).

For both National Forests in Virginia, the 1992 Forest Statistics for Virginia indicates the following inventory information as displayed in Table 3-164 by ownership class for the survey period of 1986-1991 (Johnson, Tony G. 1992, Forest Statistics for Virginia, 1992, Resour. Bull. SE-131, USDA Forest Service, Southeastern Forest Experiment Station).

Table 3-164. Virginia Timber Inventory Information by Ownership Class 1986-1991 (MMCF)

Ownership Class	Growing Stock Volume	Net Annual Growth	Net Annual Removals
National Forests	2,663	50.3	16.6
Other Public	1,300	37.0	19.2
Forest Industry	2,182	121.4	108.0
Other Private	20,342	640.0	455.0

Source: Forest Statistics for Virginia, 1992, SE-131, pp. 48-49.

When using the SAA removal-to-inventory ratios comparisons for intensity of timber production, the Virginia ratios indicate a State total of 2.26%, a "forest industry" ratio of 4.95%, an "other private" ratio of 2.24%, an "other public" ratio of 1.47%, and a National Forests ratio of 0.62%. The high industry and other private percentages are driven by activity in the Piedmont and Coastal Plains Regions of Virginia that is outside the SAA boundaries. Annual Growth exceeds net annual removal for all ownership classes with the national forests having the highest percentage margin.

For the 19 counties in Virginia containing national forest land in the Jefferson National Forest (JNF), the 1992 Forest Statistics for Virginia indicates the following inventory information as displayed in Table 3-165 by ownership class for the survey period of 1986-1991 (Johnson, Tony G. 1992, Forest Statistics for Virginia, 1992, Resour. Bull. SE-131, USDA Forest Service, Southeastern Forest Experiment Station, Forest Inventory Mapmaker Version 1.0).

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Table 3-165. Timber Inventory Information by Ownership Class 1986-1991 (MMCF)

Ownership Class	Growing Stock Volume	Net Annual Growth	Net Annual Removals
JNF Only	1,079	22.3	9.8
All Lands	6,044	137.1	87.5

Source: Forest Statistics for Virginia, 1992, SE-131, Mapmaker Version 1.0

When using the SAA removal-to-inventory ratio comparisons for intensity of timber production, the 19 counties in Virginia containing national forest land in the Jefferson National Forest (JNF), indicate an “all lands” ratio of 1.45% and a National Forests lands ratio of 0.91%. Both of these percentages are below the SAA average for comparable land ownership. Annual growth exceeds net annual removal for both ownership classes with the national forest system lands having the highest percentage margin. Annual mortality for the survey period of 1986-1991 on the Jefferson National Forest is estimated to be approximately 8.7 mmcf (Johnson, Tony G. 1992, Forest Statistics for Virginia, 1992, Resour. Bull. SE-131, USDA Forest Service, Southeastern Forest Experiment Station, Forest Inventory Mapmaker Version 1.0).

Direct, Indirect Effects, and Cumulative Effects

All environmental and social effects for the implementation of the following levels of timber management are identified under the appropriate social or resource program headings.

The following quantification displays of early successional habitat, methods of harvest, suitability, allowable sale quantities, timber sale program quantities, and average annual net present values are outputs from the SPECTRUM model. Please refer to Appendix B for detailed explanation of SPECTRUM development and application.

EARLY SUCCESSIONAL HABITAT

A variety of timber harvesting methods will be employed in each alternative to create early successional habitat. For the sake of simplicity, early successional habitat for all forest types is defined as forest 0-10 years old. Patches smaller than 2 acres are not counted. Even-aged regeneration cutting, including two-aged or coppice with reserves, counts as early successional habitat. Areas managed under uneven-aged management are considered as mid- or late successional habitat, depending on the age of the oldest significant age class. No attempt has been made to predict amounts of early successional habitat created by natural events in the future.

Table 3-166. Acres of Early Successional Habitat Created in First 10 Years.

Alternative	Acres
A	20,500
B	16,200
D	31,100
E	3,600
F	26,000
G	3,200
I	15,700

Table 3-166 displays the acres of early successional habitat created by timber harvesting for each alternative in the first 10 years.

As Table 3-166 indicates Alternative D would create the highest amount of early successional habitat in the first 10 years of plan implementation followed by Alternatives F, A, I, B, E, and G in descending order. As a point of reference, Alternative I would have 2.5% of the total forested acres in early successional habitat at the end of the first 10 years of plan implementation.

METHODS OF HARVEST

Table 3-167 displays the method of timber harvest by alternative for the first 10 years of plan implementation.

Under the latest interpretations of the NFMA and NEPA, any decisions on even-aged or uneven-aged timber harvest methods must be based on site-specific analysis during implementation. Any alternative can, however, limit or eliminate the use of timber harvest methods that do not achieve the objectives of the management prescription in any alternative or the desired future condition of the entire alternative.

As Table 3-167 displays, the seven alternatives explore the use of a wide range of timber harvesting methods to meet a variety of desired future conditions. All alternatives designate considerable lands as suitable for timber production. Uneven-aged harvest methods have generally been limited to lands that have a manageable individual area of at least 100 acres, with slopes less than 30 percent, and within ½ miles of existing roads for physical and economic reasons. All alternatives employ various amounts of group selection, except for Alternatives B and D that employ none. The greatest amount of clearcutting in employed in Alternative D, followed in decreasing amounts by Alternatives A, B, I, F, E, and G. All alternatives employ various mixes of shelterwood harvesting, and significant thinning is employed in Alternatives E and F.

Table 3-167. Acres by Method of Harvest for First 10 years for All Harvest Methods

Alternative	GS	CC	CWR	SW-2 Age BA20	SW-2 Age BA40	SW-2 Stage	Thin	Total
A	400	9,600	200	1,900	500	8,400	0	20,900
B	0	8,900	1,300	100	200	5,700	0	16,200
D	0	25,800	0	700	900	3,600	0	31,100
E	1,000	900	0	0	200	2,600	5,500	10,100
F	1,500	3,500	200	0	0	16,800	4,000	26,000
G	500	400	0	100	300	2,400	0	3,700
I	400	5,100	2,000	800	1,300	6,500	4,000	20,100

GS = Uneven-aged Management using Group Selection.

CC= Clearcut. All commercial trees are removed at initial regeneration harvest.

CWR= Coppice with Reserves. Shelterwood where residual trees are generally non-commercial or low value, which are removed at a later thinning of the new stand or at final rotation of the new stand. Regeneration is obtained primarily by stump sprouts from harvested trees.
SW-2 Age BA 20= two aged shelterwood were 20 square feet of residual trees of commercial species 8-14 inch dbh are retained in first entry. Second entry occurs in 30-40 years later with a commercial thinning and removal of older commercial species.
SW-2 Age BA 40= two aged shelterwood were 40 square feet of residual trees of commercial species 8-14 inch dbh are retained in first entry. Second entry occurs in 40-60 years later with a commercial thinning and removal of older commercial species.
SW-2 Stage= True two step shelterwood. First entry leaves about 50 BA (1/2 of original stand) and occurs about 10-20 years before final harvest cut that completely removes overstory.

Table 3-168 displays the relative amount of even-aged, two-aged and uneven-aged silvicultural systems employed during the first 10 years of plan implementation by alternative.

Table 3-169 displays the acres of planned regeneration cutting by silvicultural system and acres of intermediate harvests by alternative during the first 10 years of plan implementation.

Table 3-168. Percentage of Regeneration Acres for Even-aged, Two-aged and Uneven-aged Silvicultural Systems by Alternative in the First 10 Years

Alternative	Even-aged	Two-aged	Uneven-aged
A	86%	12%	2%
B	90%	10%	0%
D	95%	5%	0%
E	74%	4%	22%
F	34%	59%	7%
G	76%	10%	14%
I	75%	23%	2%

Table 3-169. Acres of Planned Harvesting by Even-aged System, Uneven-aged System, and Intermediate Methods by Alternative in the First 10 years

Alternative	Regeneration			Intermediate	Total
	Even-aged	Two-aged	Uneven-aged		
A	18,000	2,600	400	4,000	25,000
B	14,600	1,600	0	8,000	24,200
D	29,500	1,600	0	0	31,100
E	3,400	200	1,000	5,500	10,100
F	20,300	200	1,500	8,000	30,000
G	2,800	400	500	0	3,700
I	11,600	4,100	400	4,000	20,100

SUITABILITY

As displayed in Appendix F of the Plan, more than 89% (638,600 acres) of the Forest is "tentatively suitable" for timber production. Table 3-170 displays the acreage suitable for timber production for the seven alternatives considered.

None of the alternatives used more than 48% of the lands tentatively suitable for timber production. Alternative D contains the most lands suitable for timber production. Suitable acres vary from 127,000 to 312,000 acres.

Table 3-170. Timber Resource Land Suitability

Alternative	Thousands Of Suitable Acres	Percent Of Forest Suitable
A	278	38%
B	250	35%
D	303	42%
E	189	26%
F	302	42%
G	125	17%
I	259	36%

Table 3-171. Allowable Sale Quantity for All Products (Total for First 10 Years)

Alternative	MMCF	MMBF
A	48.1	265
B	42.3	233
D	91.1	501
E	10.0	55
F	49.5	272
G	6.2	34
I	38.5	212

ALLOWABLE SALE QUANTITY

Table 3-171 displays the allowable sale quantity (ASQ) for all products by million board feet (mmbf) and million cubic feet (mmcf) for the seven alternatives considered in detail in the DEIS. ASQ is the maximum amount of timber that can be sold on lands suitable for timber production during the first decade of implementing any alternative.

Standard Region 8 conversion of 5.5 board feet per cubic foot was used in Table 3-171 calculations to convert from cubic feet to board feet.

These alternatives have ASQs ranging from 34 to 502 mmbf per decade. As Table 3-171 indicates the seven alternatives explore a wide range of volume outputs to achieve a wide variety of desired future conditions.

Table 3-172 displays the allowable sale quantity (ASQ) for the seven alternatives by decade. Table 3-173 displays Allowable Sale Quantity (ASQ), and Long-term Sustained Yield Capacity by Alternative. All of the ASQs are well within current demand of 68 mmbf per year with reasonable likelihood of selling. Refer to following section on timber demand for methodology for establishing current timber demand and supply/demand comparison by alternative.

Table 3-172. Allowable Sale Quantity for All Products by Decade (MMCF)

Alternative	Decade 1	Decade 2	Decade 3	Decade 4	Decade 5
A	48.1	52.4	60.8	65.7	70.1
B	42.3	46.6	51.3	56.3	61.5
D	91.1	99.6	110.4	120.1	120.1
E	10.0	15.0	16.7	18.2	19.7
F	49.5	49.7	49.7	49.7	49.7
G	6.2	7.3	8.2	8.9	9.7
I	38.5	42.9	47.1	51.0	55.4

Table 3-173. Allowable Sale Quantity and Long-Term Sustained Yield Capacity by Alternative

	Alternative						
Unit of Measure	A	B	D	E	F	G	I
			MMCF / Year				
Long-term Sustained Yield	7.3	6.2	12.1	2.0	5.0	1.0	5.8
Inventory Volume, Decade 1	28.8	30.0	35.9	12.3	15.6	3.9	23.5
Total Volume Removed	5.0	4.2	9.1	1.4	5.0	0.7	4.0
			Acres / Year				
Acres Treated, Decade 1	2,090	1,625	3,110	1,010	2,600	370	2,010

TIMBER SALE PROGRAM QUANTITY

Table 3-174 displays the timber sale program quantity (TSPQ) for the seven alternatives considered in detail in the DEIS. The TSPQ is the volume of timber planned for sale during the first 10 years. It includes the ASQ from the suitable land base plus planned volume from unsuitable lands. The TSPQ is expressed as an annual average for the first 10 years of plan implementation.

Alternatives B, D, and F do not have any planned sale volume from unsuitable land; whereas, Alternatives E, G, A, and I have 29%, 11%, 5%, and 5% of the annual sale program planned on unsuitable land, respectively.

Table 3-174. Timber Sale Program Quantity (Annual Average for First 10 Years)

Alternative	MMCF	MMBF
A	5.0	27.8
B	4.2	23.3
D	9.1	50.2
E	1.4	7.7
F	4.9	27.2
G	0.6	3.8
I	4.0	21.8

Table 3-175 displays the Timber Sale Program Quantity by product. As Table 3-175 indicates the relative percents of total volume for each product various vary little among the seven alternatives. However, the amount in volume terms will vary considerably as displayed in Table 3-176.

Table 3-175. Annual Timber Sale Program Quantity by Product (% of Annual Volume)

Alterna-tive	HVHST	MVHST	LVHST	SYPST	WPST	HDRW	PRW	MMBF
A	23%	18%	14%	<1%	4%	38%	3%	27.8
B	21%	18%	15%	<1%	4%	39%	3%	23.3
D	23%	17%	13%	<1%	4%	39%	4%	50.2
E	26%	19%	15%	<1%	4%	33%	3%	7.7
F	29%	16%	12%	<1%	4%	36%	3%	27.2
G	24%	23%	18%	<1%	6%	25%	4%	3.8
I	21%	18%	15%	<1%	5%	37%	4%	21.8

HVHST=High Value Hardwood Sawtimber; MVHST= Medium Value Sawtimber; LVHST= Low Value Hardwood Sawtimber; SYPST= Southern Yellow Sawtimber; WPST=White Pine Sawtimber; HDRW= Hardwood Small Roundwood; and PRW= Pine Small Roundwood.

Standard Region 8 conversion of 5.5 board feet per cubic foot was used in calculations for Table 3-176. The “marketing niche” for the JNF is the High and Medium Value Hardwood Sawtimber Product categories. As Table 3-176 indicates, Alternative D provides the highest volume in the combined High and Medium Value Hardwood Sawtimber product categories. This is followed in descending order by Alternatives F, A, B, I, E, and G.

Table 3-176. Annual Timber Sale Program Quantity Volume by Product (MMBF). See heading definitions in Table 3-175

Alterna-tive	HVHST	MVHST	LVHST	SYPST	WPST	HDRW	PRW	TOTAL MMBF
A	6.4	5.0	3.9	0.1	1.1	10.5	0.8	27.8
B	4.9	4.2	3.5	0.1	0.9	9.0	0.7	23.3
D	11.5	8.5	6.4	0.2	2.0	19.6	2.0	50.2
E	2.0	1.5	1.2	0	0.3	2.5	0.2	7.7
F	7.9	4.3	3.2	0.1	1.1	9.8	0.8	27.2
G	0.9	0.9	0.7	0	0.2	0.9	0.2	3.8
I	4.7	3.9	3.2	0.1	1.1	8.0	0.8	21.8

NET PRESENT REVENUES

The following Table 3-177 displays the average annual net present value in millions of dollars for the timber program using SPECTRUM costs and revenues and maximizing present net value.

Table 3-177 shows how the projected revenues of the timber program within each decade and each alternative compare to the costs of the timber program. The "net" value is how much average annual revenues exceed costs. Net value is positive for all alternatives in all decades except decade 3 of Alternative G. Alternative D has the highest value through all decades except decade five when Alternative A and B surpass Alternative D in decade 5.

Table 3-177. Average Annual Net Present Value in Million of Dollars for the Timber Program

Alternative	Decade 1	Decade 2	Decade 3	Decade 4	Decade 5
A	3.86	4.89	0.81	6.71	11.83
B	2.71	3.55	8.74	12.76	12.11
D	8.37	6.48	7.76	9.21	11.32
E	1.47	1.26	2.13	3.58	4.80
F	4.29	5.83	5.58	5.52	4.08
G	0.94	0.65	(0.24)	0.87	2.64
I	1.30	1.09	3.06	8.92	10.12

DEMAND

Within the primary wood-processing industry in the Jefferson National Forest (JNF) market area is a diverse sawmill sector that serves a variety of secondary processors, including a major hardwood furniture-manufacturing industry and a growing subsector of pulp, paper and composite products.

The process paper "Methodology for Assessing Current Timber Supplies and Product Demands" (Report NE-226, 1996) established The JNF market area as generally being within an 80-mile radius around the Forest's boundary.

There are 634 sawmills and 12 pulp and fiber mills within the JNF market area with a combined consumption of 414.4 mmcf of roundwood annually. Approximately one-fourth of this material is used for the production of chips, composite products, pulp, and paper. The remainder is used in the manufacture of sawtimber products.

The ownership distribution of the “economically available” timber supply mirrors the general pattern of timberland ownership in the market area, with approximately 77 percent of the supply on NIPF land, 16 percent on the National Forest (3 percent on the JNF), 5 percent on forests owned or leased by forest industry, and 2 percent on other public timberland.

If the JNF were to satisfy current demand in the same proportion as the economically available resource supply, the estimated annual demand for all products would be 68 mmbf (414.4 mmcf times 0.03 = 12.4 mmcf or 68.2 mmbf).

SUPPLY AND DEMAND COMPARISON

Table 3-178 displays the annual timber sale quantity as a percentage of the current demand.

Demand is equal to 680 mmbf for the first 10 years of plan implementation.

As displayed in Table 3-178, no alternative meets or exceeds current market demand. Alternatives meet between 6% and 74% of current demand for timber products.

Results to date in the JNF market area indicate current consumption of economically available high-quality timber is exceeding growth of these hardwoods by 32%. It is expected that the high and medium-quality resource will be under increased pressure.

Table 3-178. Supply (TSQ) As a Percent of Current Annual Demand

Alternative	MMBF	% Of Demand
A	27.8	41%
B	23.3	34%
D	50.2	74%
E	7.7	11%
F	27.2	40%
G	3.8	6%
I	21.8	32%

When the market is segmented into high, average, and low quality categories, the current demand for the high value category is estimated to be about 32 mmbf per year of high quality hardwood sawtimber for the JNF, if the forest were to satisfy current demand in the same proportion as the economically available resource supply. As indicated in Table 3-176, Alternate D provides the highest level of high value sawtimber at the annual rate of 11.5 mmbf per year. Other alternatives provide considerably less in descending order from Alternative F, A, B, I, E, to G.

MINERAL RESOURCES

The Forest is located in southwestern Virginia, an area known from pre-colonial times to the present for a variety of valuable minerals. From the earliest Native Americans to the current population, every generation has extracted from southwestern Virginia the particular minerals needed by its generation. Energy and non-energy mineral development in southwestern Virginia is even more active over the past 20 years as the population increases and as society depends more on minerals than on wood to meet its raw material needs.

The geologic setting provides the Forest with a diversity of energy and non-energy mineral resources. Since the 1985 approval of the current Forest Plan, minerals from the Forest, including natural gas, high-quality limestone, coal, and mineral materials, have been used to meet basic needs: for heating homes, for economic development, for roads, for environmental protection, for public health and safety, etc.

The Forest contributes to rural development by helping to make available the raw materials needed for the economy (1) through exploration and development of federal mineral resources, and (2) through cooperation with the exploration and development of private mineral resources underlying federal lands. During the 1980's and 1990's, mineral activities on the Forest generated millions of dollars in revenues for federal and local government and incomes for local residents.

The Forest is located in the most important energy resource area of Virginia. The state of Virginia is a major producer and exporter of coal. Natural gas discoveries and production on and adjacent to the Forest continue to grow and are an important component of Virginia's energy base. The Forest tracts are dispersed throughout this energy-rich area.

Through various laws Congress has long recognized mineral development as an appropriate use of National Forest System lands. Minerals are a fundamental raw materials demanded by the public. Congress has also used mineral exploration and development on federal lands as a source of revenue for federal and local governments. The 2000 RPA Assessment of Forest and Range Lands (USDA Forest Service) includes mineral resources along with other resources (recreation, fish and wildlife, etc.). The 2000 RPA recognizes that markets for minerals are not only local or regional but also national and international, and that U.S. policy on minerals is affected by national security. The 2000 RPA states that increasing population is expected to lead to increasing demands for most minerals. The 2000 RPA recognizes the National importance of mineral resources in the Appalachian region, a region that includes the Jefferson National Forest.

The Southern Appalachian Assessment (SAMAB 1996a) did not include a detailed assessment of mineral resources. Everyone in the southern Appalachians uses mineral resources. The jobs, health, safety and standard of living of the entire population in the southern Appalachians depend on a continuing supply of a variety of minerals. People outside the southern Appalachians depend on mineral resources from the southern Appalachians. All National Forests programs in the southern Appalachians depend on a continuing supply of minerals. Because of the geologic setting, the National Forests in the southern Appalachians are endowed with a diversity of mineral deposits and mineral potential. Because the National Forests in the southern Appalachians occupy millions of acres in this geologic setting, the mineral potential of the National Forests is a strategic resource of regional and national importance.

The sustainability of the forests in the southern Appalachians depends on continued use of mineral resources to meet people's demands for food, fuels, building materials, etc. In the second half of 19th century and beginning of the 20th century the forests in the southern Appalachians were being devastated. The beautiful and abundant forests which stretch across the southern Appalachians today are the heritage of the historic turn from the forests to the mines in order to meet the region's and Nation's growing needs.

The role of mineral resources is fundamental to understanding human ecosystems.

Federal Leasable Minerals Management

Management of the federal leasable mineral resources is a shared responsibility between the Forest Service and the U.S. Department of Interior. The Bureau of Land Management (BLM) has a major role in issuing and supervising operations on licenses, permits, and leases for federal leasable minerals. The Interior agencies cooperate with the Forest Service to ensure that impacts upon surface resources are mitigated and that the land affected is reclaimed. The Forest does not have any lands subject to mining claims under the Mining Law of 1872 ("locatable minerals"). Minerals, such as metallic minerals, that would be "locatable minerals" on public domain lands in the western U.S. are "leasable minerals" on

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acquired lands in the eastern U.S. As a result, leasable minerals on the Forest include not only oil, gas, and coal but also hardrock or "locatable minerals" such as iron, manganese, and gold.

For all leasable minerals, except oil and gas, the Forest Plan decides which areas are available and which areas are unavailable for future leasing. Under the Revised Forest Plan, if a company applies for a lease in an area available for leasing, then an environmental analysis including public involvement would be conducted by the Forest Service in cooperation with the BLM. After the environmental analysis and public involvement, the federal government would decide whether to issue a lease.

In regard to oil and gas, the Forest Plan decides 1) which areas are available and which areas are unavailable for future leasing, and 2) in the areas available, consent for leasing with standard lease terms or with additional constraints (stipulations). Under the Revised Forest Plan, the BLM will be able to issue oil and gas leases in areas where the Plan makes both the availability and the consent decision. If a company acquires a lease, no ground disturbance can occur on the Forest unless the company applies for a permit and the Application for Permit to Drill (APD) is approved by the federal government. An environmental analysis including public involvement would be conducted by the Forest Service in cooperation with the BLM in regard to proposed roads, wells and other ground disturbance in the APD. After the environmental analysis and public involvement, the Forest Service would decide whether to approve the surface use plan of operations of the APD, and if so, with what Conditions of Approval. The BLM would decide whether to issue the APD, and if so, with what Conditions of Approval. Because of the nature of the Forest Plan decision in regard to federal oil and gas leasing, the environmental analysis and documentation is more detailed for federal oil and gas leasing than for other federal leasable minerals.

Federal Oil and Gas

Through the passage of the 1920 Mineral Leasing Act, Congress established a program to provide for oil and gas development on federal lands, including the National Forests reserved from the public domain. This Act authorizes the Secretary of the Interior to issue leases for the disposal of certain minerals (including coal, oil, oil shale, and gas). The Mineral Leasing Act for Acquired Lands of August 7, 1947 extends the provisions of the mineral leasing laws to acquired National Forest System lands and requires the consent of the Secretary of Agriculture prior to leasing. The National Forest Systems lands on the Jefferson National Forest are acquired lands. The purpose of this Act is "to promote the mining of coal, phosphate, sodium, potassium, oil, oil shale, gas, and sulphur on lands acquired by the United States."

The Energy Security Act of June 30, 1980 directs the Secretary of Agriculture to process applications for leases and permits to explore, drill and develop resources on National Forest System lands, notwithstanding the current status of the Land and Resource Management Plan ("Forest Plan"). The federal oil and gas leases issued on the Jefferson National Forest after 1980, including the oil and gas lease issued in 1984 in the North Fork Pound area of Pine Mountain, were a response to this congressional direction as well as to public demand for energy resources. In accordance with the Energy Security Act, energy leases and permits, including permits for proposed gas wells in the North Fork Pound area, will continue to be processed notwithstanding the current status of the Revision of the Jefferson Forest Plan. As part of the Federal Onshore Oil and Gas Leasing Reform Act of 1987 Congress again recognized the Forest Service's role in the federal oil and gas leasing program, and provided additional authority for Forest Service in regard to leasing and administration of surface operations during oil and gas development. The implementing regulations for this Act (36 CFR 288E) provide the basis for the analysis of Alternatives and decisions on federal oil and gas leasing in Revised Forest Plan.

Executive Order 13212 (Actions to Expedite Energy-Related Projects) of May 18, 2001 states "executive departments and agencies (agencies) shall take appropriate actions, to the extent consistent with applicable law, to expedite projects that will increase the production, transmission, or conservation of energy." The Executive Order 13212 requires that: "For energy-related projects, agencies shall expedite their review of permits or take other actions as necessary to accelerate the completion of such projects, while maintaining safety, public health, and environmental protections."

The federal oil and gas leasing program provides natural gas and other energy minerals needed by people, and provides a source of revenue to federal and local governments. Federal oil and gas leases are issued by competitive sale. A competitive sale may generate federal revenue from a bonus bid, as well as the annual rental fees for the lease acreage. If a lease is drilled and goes into production, the federal government receives a royalty on production. The revenue generated from the federal leases is shared with all the counties on the Forest. The federal government provides the counties 25 percent of all of the revenues from federal leasing (annual rental fees, production royalties, bonus bids).

Other Federal Leasable Minerals: Coal

Coal exploration and mining, including some surface mining, have occurred on lands that later became part of the Jefferson National Forest. Abandoned coal mines and prospects in southwestern Virginia, including the Clinch Ranger District, are mapped on various geologic maps published by the State or the U.S. Geological Survey. The main coal-bearing area of the Jefferson National Forest is on the Clinch Ranger District. The federal mineral estate on the Clinch Ranger District consists of scattered federal tracts, totaling about 36,000 acres within the approximately 92,000 acres of federal surface. The Surface Mining Control and Reclamation Act of 1977 prohibits surface (strip) mining of coal on the Jefferson National Forest.

Generally, the coal on the federal mineral estate has less potential for development than the coal on nearby private lands. Because coals seams on federal lands are tilted, the coal seams are more difficult to develop than flat-lying coal seams on private land. However, there are coal resources present on the federal mineral estate. The U.S. Geological Survey conducted test drilling for coal in 1982-83 on the Clinch Ranger District and in the Valley coalfields on the New River Valley and the New Castle Ranger Districts on the Jefferson National Forest. Twenty-one core holes were drilled to determine the general distribution, thickness, and quality of potentially mineable coal. The test drilling recovered coal and analyzed samples for ash content, sulphur, and calorific content. The results of the test drilling were presented in U.S.G.S Open-File Reports OF-83-620, OF-83-626, OF-83-628, and OF-83-637.

One federal coal lease for an underground coal mine was in effect on the Forest during the 1980's. After removing the mineable coal, the lease for 251 acres in Dickenson County was terminated. Since then, there has been no mining of federal coal on the Forest.

Other Federal Leasable Minerals: Non-energy Minerals

During the 19th century and early part of the 20th century, lands that now comprise the Forest were mined for metallic minerals: iron, manganese, etc. Most of the mining for metallic minerals on the lands had ceased by the 1930's when the National Forest was being created by buying the lands from private landowners. However, as a sign of the potential mineral value of these lands, many people and companies who sold the land to the Forest Service reserved the mineral rights.

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The Bureau of Land Management (BLM) prepared a report (Johnson, 1997) to assess the solid mineral potential on the Jefferson National Forest. Solid minerals include metallic minerals (gold, lead, zinc, etc.) and non-metallic minerals or industrial minerals (limestone, sandstone, shale, etc.). Using the U.S. Geological Survey's 1996 National Mineral Resource Assessment, the BLM report (Johnson, 1997) found a low potential for the occurrence and development of commercial deposits of metallic minerals on the Jefferson National Forest. The Forest has not received applications to explore for metallic deposits in recent years. In contrast, non-metallic minerals in or near the Forest have potential for occurrence and development.

In recent decades, the mining on the Forest has shifted to non-metallic minerals, such as limestone. Since 1968, the Forest and the BLM have administered a Federal lease on the New River Valley Ranger District for the underground mining of a very special, high quality limestone. High quality limestone is used in specialty applications such as (1) to control pH in water treatment and water purification plants, (2) to stabilize clay soils, (3) to replace 15 percent of wood pulp and to produce a high quality alkaline-sized paper expected to last hundreds of years longer than acid-sized paper, (4) to clean sulphur dioxide emissions from coal-fired electric power plants, and (5) to restore balance to streams and lakes affected by acid precipitation. Historically, development of non-metallic minerals in the counties where the Forest is located has been mainly on private land near or adjacent to the Forest. This trend is expected to continue.

Federal Mineral Materials

Mineral materials include aggregate, landscaping rock, rip-rap, flagstone, and other rock or earth construction materials. Mineral materials are managed by the USDA Forest Service and are not federal leasable minerals. The Forest extracts mineral materials for administrative use: to build and maintain trails, roads, campgrounds; to control erosion and sedimentation; to restore riparian and aquatic habitat; to prevent or repair flood damage; etc. The Forest also uses mineral materials extracted from mines off the Forest. The Forest issues mineral material authorizations to the public and to state and county road departments. Congress gave the Forest Service authority to sell mineral materials to the public for both commercial and non-commercial purposes, similar to Forest Service sales of wood for commercial and non-commercial purposes. The Forest can make mineral materials available as free use to governmental agencies.

Virginia Division of Mineral Resources (2002) has identified a growing problem in meeting public demand for aggregate. "Aggregate is essential for construction of new homes, commercial buildings, factories, schools, roads, railways, airports and dams. Many cities and communities are currently (or will be in the near future) experiencing aggregate shortages due to depletion of local reserves and a failure to preserve aggregate resource areas from encroaching urban development. These shortages manifest themselves in the form of higher aggregate costs due to increases in hauling distance. These price increases can in turn increase construction costs and this discourages new economic development and renewal of urban infrastructure." Another related problem is affecting rural and suburban lands as well as urban lands. Changing demographics in southwestern Virginia have made it extremely difficult or impossible to open new quarries or expand existing quarries on private lands in the counties near the Jefferson National Forest. Demand for fieldstone has been strong on the Clinch Ranger District, with several applications received through the 1990's. To date however, no commercial authorizations have been issued.

Private Mineral Rights (reserved and outstanding mineral rights) on Federal Lands

Forest Plan regulations (36 CFR 219.22) require that outstanding and reserved mineral rights (private mineral rights on NFS lands) shall be recognized to the extent practicable in forest planning. The Revised Forest Plan may make exercise of outstanding and reserved mineral rights on NFS lands more difficult in some situations. Conversely, the exercise of outstanding and reserved mineral operations may negatively affect national forest resources.

Private mineral rights (reserved and outstanding mineral rights) underlie about 12 percent of the Forest acreage (Table 3-179). Reserved rights are those retained in part or in whole by the seller when the surface was acquired by the government. Reserved rights are estimated to comprise about 8 percent of the Forest acreage. Outstanding rights are mineral rights owned by a third party when ownership of the surface was acquired by the government. Outstanding rights are estimated to comprise about 4 percent of the Forest acreage.

Table 3-179. Reserved and Outstanding Mineral Rights

Ranger District	Acres of Private Mineral Rights Reserved	Outstanding
New River Valley	3,395	11,209
Clinch	53,229	2,919
Glenwood	2,073	17
Mt. Rogers	903	11,731
New Castle	443	977
Total	**60,043**	**26,853**

Direct, Indirect and Cumulative Effects of Minerals other than Oil and Gas

OTHER FEDERAL LEASABLE MINERALS

Other Federal leasable minerals include coal and non-energy minerals. The availability of acreage to explore and develop minerals varies by Alternative (Table 3-180). If the BLM receives an application for an exploration permit or a lease in an area available for leasing, then an environmental analysis including public involvement would be conducted by the Forest Service in cooperation with the BLM. After the environmental analysis and public involvement, the federal government would decide whether to issue the permit or lease.

Table 3-180. Other Federal Leasable Minerals Availability by Alternative

	Alternative A	B	D	E	F	G	I
	(thousands of acres)						
Congressionally Withdrawn	55.7	55.7	55.7	55.7	55.7	55.7	55.7
Administratively Unavailable	70.6	67.8	63.9	117.8	0.0	195.4	81.2
Available on a Case-by-Case Basis	333.4	293.2	209.7	321.3	0.0	221.7	282.0
Available	169.0	212.0	299.4	133.9	573.0	155.9	209.8

SOCIAL AND ECONOMIC DEVELOPMENT

MINERAL RESOURCES

Minor new activity is anticipated for other federal leasable minerals over the next 15 years. This activity would be mainly exploration. If a mine were proposed, it most likely would be an underground mine. If any federal coal were to mined it would be underground mining in conjunction with needed access to underground mining of private coal. The acres of federal coal activity (surface facilities for underground mining) is estimated to be about 5% of the acres of private coal in the 5th level HUC watershed 0601020504 (Stony/Guest/Clinch watershed). Under all Alternatives, the existing Federal lease for the underground mining of high quality limestone would continue on the New River Valley Ranger District. The only mine working for the underground limestone operation that might be needed on the National Forest surface in the future is an airshaft.

The potential for the Forest to receive applications to explore for metallic deposits in the next 15 years is estimated to be low.

FEDERAL MINERAL MATERIALS

Mineral materials include road aggregate, landscaping rock, rip-rap, flagstone, and other rock or earth construction materials. The availability of acreage to meet demand from local residents and public agencies and commercial users varies by Alternative (Table 3-181). Administrative use of mineral materials by the Forest is allowed in all Management Prescriptions, with specific restrictions in some cases. Administrative use includes building and maintaining trails, roads, campgrounds; controlling erosion and sedimentation; restoring riparian and aquatic habitat; repairing or preventing flood damage. The acres disturbed from future use of federal mineral materials during Plan implementation are estimated to be less than 30 acres. The acres disturbed and reclaimed from past, present and future use of federal mineral materials are estimated by fifth level HUC watershed (Table 3-182). Most of the mineral materials used by the Forest are extracted from mines off the Forest.

Table 3-181. Federal Mineral Materials Availability by Alternative

	Alternative						
	A	B	D	E	F	G	I
	(thousands of acres)						
Unavailable for Commercial, Personal, and Free Uses	231.8	302.2	191.9	286.1	58.2	392.2	250.6
Unavailable for Commercial and Personal Uses. Available for Free Uses	71.2	77.1	83.9	103.5	0.0	76.6	102.2
Available for Commercial, Personal, Free Uses	420.3	344.0	447.5	333.7	665.1	254.5	370.5

PRIVATE COAL MINERAL RIGHTS (RESERVED AND OUTSTANDING MINERAL RIGHTS) ON FEDERAL LANDS

Underground mining of private coal under federal surface has occurred sporadically on the Clinch Ranger District. Underground mining involves some use of the land surface for above ground facilities, such as equipment storage, stockpiling, truck-loading areas, weigh scales, etc.

In addition, exploration for private coal under federal surface has occurred sporadically on the Clinch Ranger District. Exploration involves activities such as drilling, trenching and geophysical exploration. These exploration and underground mining activities occurred in the 5th level HUC watershed 0601020504, which is the Stony/Guest/Clinch watershed.

Table 3-182. Estimated Acres Disturbed and Reclaimed from Past, Present and Future Use of Federal Mineral Materials by Fifth Level HUC Watershed

	Acres of Projected Disturbance and Reclamation by Decade									
		Decade 1		Decade 2		Decade 3		Decade 4		Decade 5
5th Level HUC Watershed	Existing	Projected	Reclaimed	Estimated Existing	Projected	Estimated Existing	Reclaimed	Estimated Existing	Reclaimed	Estimated Existing
0208020102	0	0	0	0	0	0	0	0	0	0
0208020103	1.54	0.77	0.51	1.8	0.39	2.18	0.77	1.41	0.39	1.03
0208020106	0	0	0	0	0	0	0	0	0	0
0208020107	1.01	0.5	0.34	1.18	0.25	1.43	0.5	0.93	0.25	0.67
0208020108	7.21	3.6	2.4	8.41	1.8	10.21	3.6	6.61	1.8	4.81
0208020109	1.99	0.99	0.66	2.32	0.5	2.81	0.99	1.82	0.5	1.32
0208020205	0.16	0.08	0.05	0.19	0.04	0.23	0.08	0.15	0.04	0.11
0208020301	0.62	0.31	0.21	0.73	0.16	0.88	0.31	0.57	0.16	0.42
0301010101	0.1	0.05	0.03	0.12	0.03	0.15	0.05	0.1	0.03	0.07
0301010102	0.08	0.04	0.03	0.09	0.02	0.12	0.04	0.07	0.02	0.05
0301010107	0.17	0.08	0.06	0.2	0.04	0.24	0.08	0.16	0.04	0.11
0301010108	0.25	0.12	0.08	0.29	0.06	0.35	0.12	0.22	0.06	0.16
0505000101	0.27	0.14	0.09	0.32	0.07	0.38	0.14	0.25	0.07	0.18
0505000103	0.27	0.13	0.09	0.31	0.07	0.38	0.13	0.24	0.07	0.18
0505000104	0.64	0.32	0.21	0.75	0.16	0.9	0.32	0.59	0.16	0.43
0505000105	0.55	0.27	0.18	0.64	0.14	0.77	0.27	0.5	0.14	0.36
0505000106	0.24	0.12	0.08	0.28	0.06	0.34	0.12	0.22	0.06	0.16
0505000107	1.44	0.72	0.48	1.68	0.36	2.04	0.72	1.32	0.36	0.96
0505000108	1.6	0.8	0.53	1.87	0.4	2.27	0.8	1.47	0.4	1.07
0505000110	1.16	0.58	0.39	1.35	0.29	1.64	0.58	1.06	0.29	0.77
0505000201	1.65	0.83	0.55	1.93	0.41	2.34	0.83	1.52	0.41	1.1
0505000202	3.05	1.52	1.02	3.56	0.76	4.32	1.52	2.79	0.76	2.03
0505000203	1.51	0.75	0.5	1.76	0.38	2.13	0.75	1.38	0.38	1.0
0505000204	0.22	0.11	0.07	0.26	0.06	0.32	0.11	0.2	0.06	0.15
0505000207	0.01	0	0	0.01	0	0.01	0	0.01	0	0.01
0505000210	0.01	0.01	0	0.01	0	0.02	0.01	0.01	0	0.01
0507020203	0.08	0.04	0.03	0.09	0.02	0.11	0.04	0.07	0.02	0.05
0507020205	0.87	0.43	0.29	1.01	0.22	1.23	0.43	0.8	0.22	0.58
0507020206	0.01	0	0	0.01	0	0.01	0	0.01	0	0
0513010101	0.04	0.02	0.01	0.04	0.01	0.05	0.02	0.03	0.01	0.02
0601010101	1.35	0.68	0.45	1.58	0.34	1.91	0.68	1.24	0.34	0.9
0601010201	3.08	1.54	1.03	3.59	0.77	4.36	1.54	2.82	0.77	2.05
0601010202	1.1	0.55	0.37	1.29	0.28	1.56	0.55	1.01	0.28	0.74
0601020504	1.83	0.92	0.61	2.14	0.46	2.59	0.92	1.68	0.46	1.22
0601020505	0.87	0.43	0.29	1.01	0.22	1.23	0.43	0.8	0.22	0.58
0601020601	0.87	0.43	0.29	1.01	0.22	1.23	0.43	0.79	0.22	0.58
Total	**35.85**	**17.92**	**11.95**	**41.82**	**8.96**	**50.78**	**17.92**	**32.86**	**8.96**	**23.9**

SOCIAL AND ECONOMIC DEVELOPMENT

MINERAL RESOURCES

For the Revised Forest Plan EIS, Table 3-183 displays the estimated acres, by decade, of clearing and reclamation associated with surface facilities for underground coal mining and exploration in the 5th level HUC watershed 0601020504 (Stony/Guest/Clinch watershed). Mine operations are estimated to last 20 years.

Table 3-183. Estimated acres, by decade, of clearing and reclamation associated with surface facilities for underground coal mining and exploration in the Stony/Guest/Clinch Watershed

Acres	Activity
	Decade 1
50	Surface clearing for underground mine.
5	Cleared for exploration and reclaimed within year after exploration.
	Decade 2
25	Surface clearing for underground mine.
5	Cleared for exploration and reclaimed within year after exploration.
	Decade 3
50	Reclaimed
	Decade 4
25	Reclaimed

PRIVATE MINERAL RIGHTS (RESERVED AND OUTSTANDING MINERAL RIGHTS) ON FEDERAL LANDS

The exercise of private mineral rights produces both mineral exploration and mineral development in various areas, with most activity on the Clinch Ranger District.

The Forest administers a variety of mineral exploration and development operations undertaken by private individuals and companies on federal surface. In recent years the Forest has been administering private plans of operations on federal surface for (1) the development of the South Coeburn gas field, (2) an underground coal mine which supplies local users as well as a Florida power utility, and (3) a sand mine that is one of the few suppliers of non-skid surfacing for highways in western Virginia.

The following section discusses two interrelated potential effects relating to outstanding and reserved mineral rights on the Jefferson National Forest: 1) the potential effects of the Revised Forest Plan Alternatives on the exercise of outstanding and reserved mineral rights on NFS lands; and 2) the potential effects of outstanding and reserved mineral operations on NFS lands.

The exercise of private mineral rights (reserved and outstanding) to explore and develop privately-owned minerals on NFS lands is a private decision, not a federal decision. Tens of thousands of acres of the Jefferson National Forest System lands were acquired subject to these private mineral rights. All Forest Plan Alternatives (including Forest-wide Direction and Management Prescription direction) are subject to these existing private rights (outstanding and reserved mineral rights).

A Comptroller General Report to Congress (GAO/RCED-84-101; July 26, 1984) found that the Forest Service in the eastern U.S. failed to provide Congress with information about private mineral rights and their potential effect on wilderness management. After designating many Wilderness areas in the eastern U.S., Congress was concerned about tens of millions of dollars that the Forest Service then said could be needed to acquire private mineral rights in several Wildernesses. The Forest Service was faced with management problems, litigation, and administrative costs, and was looking to Congress to purchase the private mineral rights. As the GAO noted: “Recent attempts by the federal government to acquire private mineral rights and prevent development in eastern wilderness areas have caused considerable controversy and congressional debate primarily because of the high costs associated with these purchases.”

The GAO recommendation to the Secretary of Agriculture was: “Because the Forest Service did not analyze the potential problems or costs associated with private mineral rights when it developed its 1979 wilderness recommendations, GAO recommends that the Secretary direct the Forest Service’s southern and eastern regional offices to do this type of analysis when reevaluating its wilderness recommendations. This analysis should include for each area consideration of private mineral development potential, the government’s ability to control mineral development if it occurs, the need to acquire private mineral rights, and a range of acquisition costs.”

These problems (management conflicts, litigation, and high costs) apply not only to Wilderness, but to 1) any highly restrictive designation that conflicts with exercise of private mineral rights on National Forest System lands, and 2) management prescriptions that impose severe restrictions on use of the surface or prohibit certain activities such as road construction or mining. Examples include Special Biological Areas, Appalachian Trail Locations/Relocations, Wild & Scenic River designations, Wilderness Study Areas, or backcountry recreation areas. In 1997, the Jefferson National Forest spent more than $300,000 to acquire private minerals interests and lands to shut down a private sand mine deemed inappropriate near the Appalachian Trail in Smyth County. Currently the Jefferson National Forest is evaluating purchase of another private mineral interest in NFS land near the Appalachian Trail in Smyth County.

The 5th Amendment to the U.S. Constitution provides that private property shall not be taken for public use without just compensation. In addition to designation or prescriptions that prohibit mining or are de facto prohibitions on mining, a “taking” can have other forms. For example, the time required to process private mineral activities under the Forest Plan's framework might result in unreasonable delays that amount to a "taking" of the mineral rights. Partial takings are also possible. Executive Order 12630 "Governmental Actions and Interference with Constitutionally Protected Property Rights" was signed in 1988. E.O. 12630 requires federal decision-makers to 1) evaluate carefully the effect of their administrative actions on private property rights, and 2) to show due regard to these 5th amendment rights and to reduce the risk of undue or inadvertent burdens on the federal treasury. Concern about government "takings" of private property rights is a national issue. In 1995, Congress held hearings on this issue.

The Revised Forest Plan Alternatives vary in the extent to which they create potential conflicts with private mineral rights (Table 3-184). An indicator of the potential for conflict was developed based on the five categories of federal oil and gas leasing availability/ consent applied to management prescriptions. These categories apply to federal oil and gas leasing, and not directly to the private mineral rights. But the categories show the level

Table 3-184. Private Mineral Estate Areas of Potential Conflict

	Alternative						
	A	B	D	E	F	G	I
	(thousands of acres)						
High Potential for Conflict	14.9	14.3	12.3	21.5	2.5	21.8	23.1
Moderate Potential for Conflict	49.1	42.8	31.4	52.8	0.0	45.8	36.8
Low Potential for Conflict	30.6	37.5	50.9	20.3	92.1	27.0	34.7

of restrictions placed on federal oil and gas activities, and thus, indirectly indicate potential for conflict with exercise of private mineral rights. The five categories were simplified into three categories relevant to private mineral rights. Similarly, Alternatives with the largest acreage in High or Moderate Potential for Conflict have the most potential for private mineral rights to have adverse effects on management prescriptions that prohibit or severely restrict surface use.

FEDERAL OIL AND GAS REASONABLY FORESEEABLE DEVELOPMENT SCENARIO

Oil and Gas Potential

The Jefferson National Forest is located within three physiographic provinces, the Appalachian Plateau (locally Cumberland Plateau), the Valley and Ridge, and the Blue Ridge. Because most of the subsidence occurred during Paleozoic time (from 570-245 million years ago), the Appalachian Plateau and the Valley and Ridge are considered part of a large Paleozoic basin known as the Appalachian Basin. There may be more than 30,000 feet of Paleozoic sediments in the Appalachian Plateau and Valley and Ridge. The bedrock is composed mainly of sandstone, shale, and limestone.

More than 3,000 wells have been drilled in southwestern Virginia. The primary hydrocarbon production is natural gas. Natural gas energy development is widespread in Buchanan, Dickenson, and Wise Counties, and is in patches in Lee, Russell, Scott, Tazewell, and Washington Counties. Some oil production occurs in Lee and Wise Counties.

The Clinch Ranger District is located in southwestern Virginia in an area of proven hydrocarbon production. Natural gas is produced from federal oil and gas leases as well as reserved mineral rights on the Clinch Ranger District. The Clinch Ranger District is estimated to have a high potential for hydrocarbons, primarily natural gas.

Exploration drilling conducted in the 1980's in scattered locations on private lands in the Valley and Ridge physiographic province was generally not successful in the portion of the Valley and Ridge where the New River Valley and New Castle Ranger Districts are located. These areas do contain source rocks such as shale and some coal. Some gas exploration and development has been successful on non-federal lands in the Valley and Ridge physiographic province near the border of Scott and Washington Counties. The New River Valley and New Castle Ranger Districts are estimated to have a moderate potential for hydrocarbons, primarily natural gas.

The Blue Ridge physiographic provinces is composed mainly of igneous and metamorphic rocks, and is not considered a likely source for hydrocarbons. No exploration drilling has been conducted on the Blue Ridge where the Mount Rogers National Recreation Area and Glenwood Ranger District are located, and these Districts are estimated to have a low potential for hydrocarbons.

Past And Present Oil And Gas Leasing

FEDERAL OIL AND GAS LEASING ON JEFFERSON NATIONAL FOREST

In response to the energy crisis of the 1970's and then to the continuing public demand for energy, federal oil and gas leasing was very active on the Forest during the 1980's. The federal government issued federal oil and gas leases on hundreds of thousands of acres of the Forest during the 1980's. This high level of federal leasing activity was similar to the high level of leasing activity on private lands in southwest Virginia prompted by the energy crisis of the 1970's (see next section on private oil and gas leasing).

Exploration drilling conducted in the 1980's on private lands in or near the Forest was very successful in the Cumberland Plateau physiographic province, including Wise and Dickenson Counties where the Clinch Ranger District is located. This success led to successful exploration drilling and development of natural gas on federal oil and gas leases at the northeast end of Pine Mountain in Dickenson County in the early 1990's. As a result, federal leases on the Clinch Ranger District remained in effect longer than on other Ranger Districts.

In contrast, exploration drilling conducted in the 1980's on private lands in the Valley and Ridge physiographic province was generally not successful in the portion of the Valley and Ridge where the New River Valley and New Castle Ranger Districts are located. No exploration wells were drilled on federal oil and gas leases on these Ranger Districts. Because the Blue Ridge physiographic province is considered to have low potential for oil and gas, no exploration drilling was conducted on the Blue Ridge where the Mount Rogers National Recreation Area and Glenwood Ranger District are located. Because of a lack of successful exploration on private lands in the vicinity of the New River Valley and New Castle Ranger Districts, the federal lessees decided not to conduct exploration drilling on federal leases on the New River Valley and New Castle Ranger Districts.

By the mid-1990's, the only federal oil and gas leases still in effect were on the Clinch Ranger District. The federal mineral estate on the Clinch Ranger District is about 36,230 acres of the almost 92 thousand federal surface acres. In October 1993, about fifty federal oil and gas leases were in effect on about 36,000 acres on the Clinch Ranger District. All the federal leases issued on the other Ranger Districts had been relinquished, terminated, or expired by the mid-1990's.

As of June 2002, fourteen federal oil and gas leases were in effect on 14,979 acres of the Forest on the Clinch Ranger District, mostly in the Pine Mountain area (See Figure 3-6). As of June 2002, a public nomination or request for federal leases was pending on 5,191 acres on the Clinch Ranger District west of Keokee Lake in Lee County.

PRIVATE OIL AND GAS LEASING ON OR IN VICINITY OF JEFFERSON NATIONAL FOREST

The federal oil and gas leasing activity since the 1980's reflected the private oil and gas leasing activity in the southwest part of Virginia where the Jefferson National Forest is located. During the 1980's leasing occurred throughout this part of Virginia on 1) private mineral rights (outstanding and reserved mineral rights) on National Forest System lands (federal surface/private mineral rights), and 2) private lands (private surface/private mineral rights). Like the federal lease acreage, the acreage under private lease was reduced during the late 1980's and then the 1990's in areas where exploration was not successful, particularly in the in the portion of the Valley and Ridge where the New River Valley and New Castle Ranger Districts are located. The result was that by the mid-1990's the private oil and gas leases still in effect were largely in the southwestern Virginia counties where exploration was successful, including the counties where the Clinch Ranger District is located. The private mineral estate (outstanding and reserved mineral rights) on the Clinch Ranger District is about 55,640 acres of the almost 92 thousand federal surface acres.

Past And Present Oil And Gas Exploration And Development

The search for natural gas from the 1970's to the 1990's was successful in several areas in southwestern Virginia. The discoveries of natural gas deposits led to the development and production of natural gas from many areas in southwestern Virginia including federal land in Wise and Dickenson Counties where the Clinch Ranger District is located. Natural gas production on the Forest has been conventional gas. Natural gas production off the Forest has been conventional gas and coal bed methane gas.

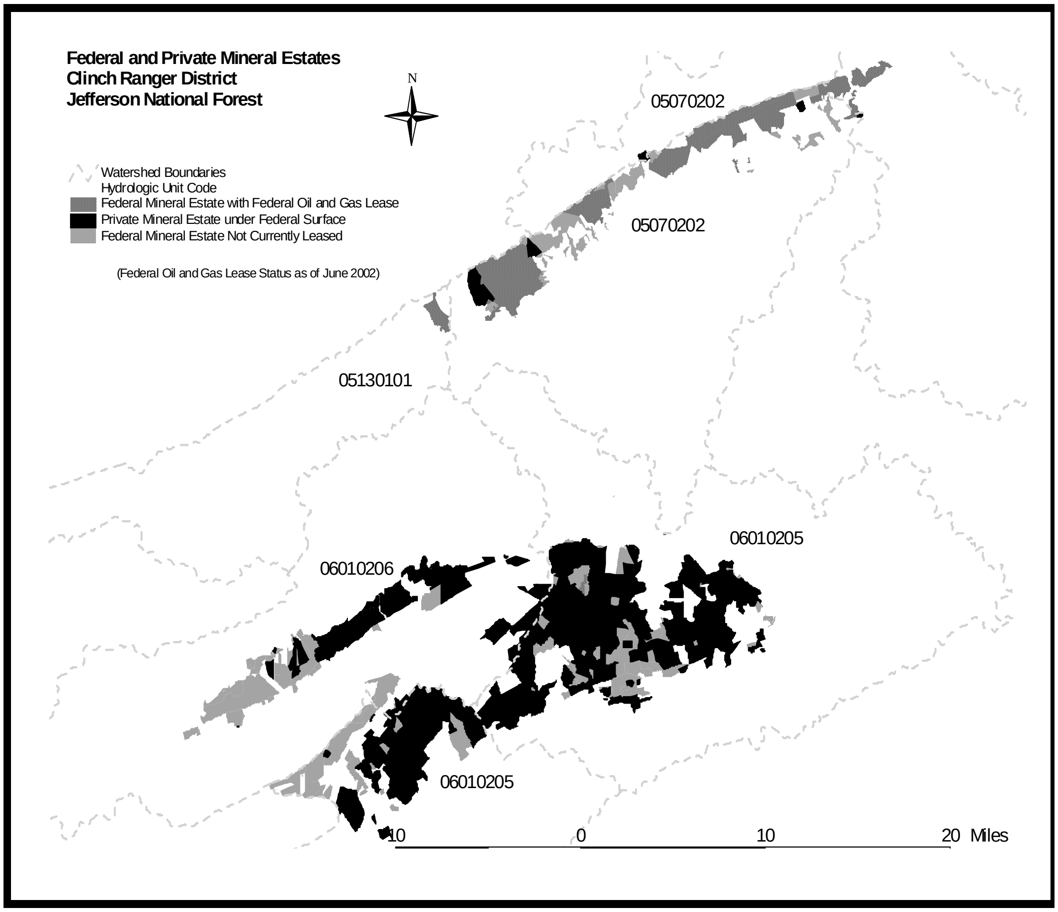

Figure 3-6. Clinch Ranger District Federal and Private Mineral Estates

FEDERAL OIL AND GAS EXPLORATION AND DEVELOPMENT ON JEFFERSON NATIONAL FOREST

From the early 1990's to the present, the Forest and the BLM have administered the development and production of natural gas fields and associated pipelines on federal oil and gas leases in the Pine Mountain area. During the early 1990's, six gas wells were drilled on federal oil and gas leases on the Clinch Ranger District at the northeast end of Pine Mountain between Russell Fork and the Virginia/Kentucky state line. As of June 2002 the status of the wells are: four producing gas wells; one shut in gas well; and one well plugged and abandoned. These existing wells on National Forest are located in the 5th level HUC 0507020203 watershed (See Table 3-185).

Some federal leases on Pine Mountain are also producing gas as a result of gas wells drilled on adjacent non-federal land. A 4,836-acre federal oil and gas lease was issued in 1984 in the North Fork Pound area of Pine Mountain. Since the early 1990's, natural gas has been produced from a small part of the lease from a gas well located on private land adjacent to the lease area. In 2002, the lessee filed with the Bureau of Land Management a Notice of Staking to drill 21 gas wells on the federal lease and construct 11 miles of

Table 3-185. Estimated number of wells from past and present oil and gas exploration and development (as of 2000-2001) by fifth level HUC watershed containing National Forest System lands on Clinch Ranger District

Fifth level HUC watershed	Number of Wells		
	Federal On-Forest	Private On-Forest	Private Off-Forest
0507020205	0	0	116
0601020504	0	69	125
0601020505	0	0	3
0601020601	0	0	240
0507020203	6	0	529
0513010101	0	0	61
Total	**6**	**69**	**1,074**

road to develop natural gas from the lease. Nearly all the proposed gas development would occur within the North Fork of Pound roadless area, inventoried as roadless in 1997 as part of the roadless inventory for the Jefferson Forest Plan Revision process. The Forest Service and BLM are conducting an environmental analysis regarding Applications for Permit to Drill for the 21 gas wells and associated roads and pipelines. These proposed wells on National Forest are located in the 5th level HUC 0507020205 watershed.

In 2000, a federal oil and gas lessee drafted preliminary plans for 41 gas wells and about 30 miles of road construction on 5,605 acres of federal leases on Pine Mountain between Big Lick Gap and Skeet Rock Knob. The lessee however did not submit an Application for Permit to Drill for the 41 gas wells to the federal government. The lessee had a change of plans, and transferred the lease to another energy company. These proposed wells on National Forest are located in the 5th level HUC 0507020205 watershed.

Outside of the Clinch Ranger District, no oil and gas exploration or development wells have been drilled on federal oil and gas leases on the other Ranger Districts on the Jefferson National Forest.

PRIVATE OIL AND GAS EXPLORATION AND DEVELOPMENT (OUTSTANDING/RESERVED MINERAL RIGHTS) ON JEFFERSON NATIONAL FOREST

Throughout the 1990's and continuing to the present, the owners of private mineral rights have explored and developed the South Coeburn natural gas field on the Clinch Ranger District (federal surface/private (reserved) mineral rights). Previous exploration drilling in the 1970's in this area resulted in several dry holes. The development of the South Coeburn gas field has proceeded from the vicinity of State Route 72 westerly toward State Route 619. The development of access roads, well sites and pipelines has been mainly in Wise County. The South Coeburn gas field is within the 5th level HUC 0601020504 watershed. As of 2002, there are 59 gas wells in production, two gas wells shut in, and eight unsuccessful gas wells (dry holes) on National Forest System lands in the 5th level HUC 0601020504 watershed.

Outside of the Clinch Ranger District, no oil and gas exploration or development wells have been drilled on private (outstanding/reserved) mineral estates on the other Ranger Districts on the Jefferson National Forest.

SOCIAL AND ECONOMIC DEVELOPMENT

MINERAL RESOURCES

FEDERAL OIL AND GAS REASONABLY FORESEEABLE DEVELOPMENT SCENARIO (RFD)

GEOPHYSICAL EXPLORATION ON THE JEFFERSON NATIONAL FOREST

Geophysical exploration may occur regardless of whether a lease is issued. Instead of drilling or excavating deep into the earth, geophysical exploration uses indirect methods to assess subsurface geology for oil and gas or other minerals. The Forest received less than 10 requests for geophysical exploration in the past 15 years. The most common geophysical exploration on the Forest uses vibroseis, conducted using trucks with metal plates that vibrate the ground at intervals along existing roads. Where roads are not available, explosive charges, usually placed in holes drilled to depths of less than 10 feet, are set off at intervals. Both these methods uses geophones placed in the ground to detect the seismic wave from the source (vibration or shot). A separate permit is issued for each geophysical operation. Over the life of the Revised Plan, it is estimated that 15 permits for geophysical exploration would be issued in regard to federal and private mineral rights exploration on the forest. The average length of the survey line for the permit is estimated to be four miles, with 75% of the length on existing roads, and 25% cross-country.

OIL AND GAS EXPLORATION AND DEVELOPMENT OFF THE JEFFERSON NATIONAL FOREST

From the 1970's to the present, oil and gas exploration and development has been occurring in the Cumberland Plateau area of southwestern Virginia, predominantly on non-federal lands. This energy development is widespread in Buchanan, Dickenson, and Wise Counties, and is in patches in Lee, Russell, Scott, Tazewell, and Washington Counties. For the portion of this energy development occurring in fifth level HUC watersheds containing National Forest System lands on the Clinch Ranger District, the past and present oil and gas activity, including the number of wells off the Forest, is indicated in Table 3-185.

Outside of the Cumberland Plateau physiographic province and Clinch Ranger District, some oil and gas exploration and development has been successful on non-federal lands in the Valley and Ridge physiographic province near the border of Scott and Washington Counties. In this area, gas wells have been developed in the Mississippian age formations. But farther northeast, in the parts of the Valley and Ridge where the New River Valley and New Castle Ranger Districts are located, sporadic and scattered exploration drilling has not been successful. Because the Blue Ridge physiographic province is considered to have low potential for oil and gas, no exploration drilling was conducted on the Blue Ridge where the Mount Rogers National Recreation Area and Glenwood Ranger District are

Table 3-186. Estimated number of wells from past and present oil and gas exploration and development (as of 2000-2001) by fifth level HUC watershed containing Jefferson National Forest system lands, except for the Clinch Ranger District

Fifth level HUC watershed	Number of Wells		
	Federal On-Forest	Private On-Forest	Private Off-Forest
0208020103	0	0	1
0208020107	0	0	1
0301010101	0	0	1
0505000108	0	0	2
0505000110	0	0	7
0505000202	0	0	2
0505000203	0	0	1
0601010101	0	0	4
0601010202	0	0	2
Total	**0**	**0**	**21**

located. For fifth level HUC watersheds with drilled wells and Jefferson National Forest System lands outside the Clinch Ranger District, the past and present oil and gas activity, including the number of wells off the Forest, is indicated in Table 3-186. All the wells were dry holes.

Federal Oil And Gas Leasing By Forest Plan Alternative

Congress passed a law in 1987 that updated and enlarged the Forest Service role and authority in leasing federal oil and gas on National Forest System lands (Federal Onshore Oil and Gas Leasing Reform Act of 1987). The determination of lands administratively available/unavailable and consent to leasing for the Revised Forest Plan was developed based on the law and the implementing regulations, including 36 CFR 228E. The Federal oil and gas leasing availability and consent decision varies for each Forest Plan Alternative (Table 3-187). All Alternatives are subject to existing federal oil and gas leases in effect at time of approval of Revised Forest Plan. The existing oil and gas leases, including leases held by production, are valid existing rights in place before the Revised Forest Plan is approved.

Table 3-187. Federal Oil and Gas Leasing Availability and Consent Decision by Alternative

Availability and Consent Leasing Decision	Alternative (thousands of acres) A	B	D	E	F	G	I
Congressionally Withdrawn (No Consent)	55.7	55.7	55.7	55.7	55.7	55.7	55.7
Administratively Unavailable (No Consent)	32.5	27.1	24.7	82.4	0.0	157.8	44.6
Available/Consent with No Surface Occupancy Stipulation	101.1	102.0	67.2	133.2	0.0	63.0	195.9
Available/Consent with Additional Stipulations like Controlled Surface Use	253.0	231.9	181.7	252.1	0.0	196.7	140.5
Available/Consent with Standard Stipulation	186.4	212.0	299.4	105.3	573.0	155.5	192.0

Under Alternative F, the 1986 Forest Plan, additional stipulations, including no surface occupancy, within these areas are identified on a case-by-case basis.

The determination of lands administratively availability and the consent for leasing specific lands are based on the multiple use mix designed for each Management Prescription. Congressionally withdrawn areas, such as Wilderness, are closed to leasing. Each Management Prescription not closed by law or regulation was examined to determine availability/unavailability and the consent for leasing specific lands. The lease availability/consent determination has four options: 1. Unavailable and No Consent to Lease, 2. Available and Consent to Lease with Standard Stipulation, 3. Available and Consent to Lease with Additional Stipulations like Controlled Surface Use, 4. Available and

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Consent to Lease with No Surface Occupancy Stipulation. Each Management Prescription was evaluated to see which one of the lease consent options would be a reasonable addition to the multiple use mix of the Management Prescription, including providing protections for other resources. Each Management Prescription was assigned one of the four options based on the multiple use mix of the Management Prescription. For example, Management Prescriptions that are similar to Wilderness (such as 1B Recommended Wilderness or 12C Natural Processes in Backcountry Remote Areas) were made administratively unavailable. In contrast, Management Prescriptions that allowed for a wider range of management activities (such as 8A1 Mix of Successional Habitats in Forested Landscapes) were made administratively available and provided consent to lease with standard stipulation. The administratively available/unavailable and the consent to lease status for each Management Prescription is found in the Forest Plan by reference to the Forest-wide standard for oil and gas leasing and, if present, a management prescription standard for oil and gas leasing that differs from the Forest-wide standard. The Alternatives were developed by varying the acreage assigned to Management Prescriptions. The acreage assigned to administratively available/ unavailable and consent to lease options varied as the acreage assigned to Management Prescriptions varied under each Alternative.

The need for withdrawals was considered in the Recommended Wilderness Study Areas for each Alternative. If Congress establishes any of these Areas as Wilderness, then the Areas will be withdrawn. The need for withdrawals was also considered on other lands, but found to be unnecessary. The purpose of a withdrawal is to prohibit surface disturbing activities, such as mining and road construction, in specific areas. Withdrawals are needed in the western U.S. where lands are statutorily open by the Mining Law of 1872 (locatable minerals). On those western lands, a Forest must seek a withdrawal if it desires to prohibit surface disturbing activities from locatable mining operation. But the Jefferson National Forest is not subject to the Mining Law of 1872. The minerals on the Forest are leasable, not locatable minerals. Because the Forest Service has more authority over leasable minerals on acquired lands, compared with locatable minerals on reserved public domain lands, the Forest can prohibit surface disturbing activities without a withdrawal. The Forest can decide to make lands administratively unavailable. So, the Forest does not need a withdrawal to prevent oil and gas leasing in unleased lands. The Alternatives considered the need to make lands administratively unavailable (similar to withdrawal) in each Alternative. In addition, the Forest Service can decide to lease with a No Surface Occupancy (NSO) stipulation. A NSO stipulation prohibits road construction, well drilling, and other surface disturbing activity on a lease. The effect of an NSO Stipulation applied to a specific area is similar to a withdrawal: no surface disturbing activities would occur in the area. The Alternatives considered the need for NSO Stipulations (similar to withdrawal) in each Alternative.

Areas closed to leasing (no consent) include 1) congressionally withdrawn areas, such as wilderness, and 2) administrative unavailable areas. Under each Alternative, the acreage the USDA Forest Service consents to lease is acreage the Bureau of Land Management (BLM), Department of Interior would be allowed to lease. Under any Alternative, the acres that might be disturbed by oil and gas activities (roads, well pads, pipelines, etc.) are less than 1% of acres available or consented to lease (see Tables on Reasonably Foreseeable Development). Exploration for minerals requires that large areas be searched because mineral deposits suitable for mining are scarce. Much of this searching does not disturb the ground (geologic mapping; study of existing data from past exploration or development; analysis of satellite imagery, remote sensing imagery, aerial photos). If an area looks promising, some additional data may be gathered (geophysical surveys, geochemical surveys, small rock samples). These activities involve minor amounts of ground disturbance. Most searches are abandoned by this point because mineral deposits suitable for mining are scarce. If however a site shows promise then an exploration well may be drilled. If additional drilling confirms a deposit suitable for development, then the infrastructure is constructed and production can begin. Because mineral deposits are concentrated or can be extracted from a compact area, like a well pad, the acreage needed for infrastructure is relatively small.

Areas administratively available and with consent to lease vary by type of lease consent: 1) consent with standard lease terms and Stipulation for National Forest System lands, 2) consent with additional stipulations like Controlled Surface Use Stipulation, and 3) consent with No Surface Occupancy Stipulation. The three types of lease consent are discussed below.

1) CONSENT TO LEASING WITH STANDARD LEASE TERMS AND STIPULATION FOR NATIONAL FOREST SYSTEM LANDS provides a wide range of federal and state laws, regulations, and standards to enforce environmental protections on oil and gas exploration and development.

Environmental protections in Section 6 of the standards lease terms include requirements such as:

"Conduct of operations - Lessee shall conduct operations in a manner that minimizes adverse impacts to the land, air, and water, to cultural, biological, visual, and other resources, and to accomplish the intent of this section. To the extent consistent with lease rights granted, such measures may include, but are not limited to, modification to siting or design of facilities, timing of operations, and specification of interim and final reclamation measures. Lessor reserves the right to continue existing uses and to authorize future uses upon or in the leased lands, including the approval of easements or rights-of-ways. Such uses shall be conditioned so as to prevent unnecessary or unreasonable interference with rights of lessee."

The Stipulation for National Forest System lands requires the lessee to comply with the Secretary of Agriculture's rules and regulations for use and occupancy of National Forest System lands prior to approval of a permit/operation plan by the Secretary of Interior.

Proposed lease operations are subject to the Endangered Species Act, Archaeological Resources Protection Act, Federal Water Pollution Control Act, Clean Water Act, Clean Air Act, and all the other environmental protection laws and regulations applicable to National Forest System lands.

Proposed lease operations are subject to environmental protection requirements in Forest Service regulations, including the 36 CFR 228E regulations developed to implement Federal Onshore Oil and Gas Leasing Reform Act of 1987. Proposed lease operations are subject to environmental protection requirements in BLM regulations and Onshore Oil and Gas Order No. 1, other onshore oil and gas orders, and Notice to Lessees issued pursuant to federal regulations.

Proposed lease operations are subject to the State laws and regulations governing oil and gas operations, including requirements for environmental protection and reclamation. According to the Virginia Division of Oil and Gas (2002), "Virginia's Gas and Oil Act of 1990 and the regulation authorized by that act, provides a comprehensive program to protect public safety and the environment from potential impacts associated with gas and oil exploration and development. The law and regulation govern activities from prior to the initial disturbance of land for site preparation until after a well is plugged and reclaimed. The installation and operation of gathering pipelines are also governed by the law and regulation. The Department of Mines, Minerals and Energy's (DMME) Division of Gas and Oil (DGO) is responsible for administering the law and regulation.

The law and regulation require an operating permit and place special emphasis on water quality protection, erosion and sediment control, and protection of the public from safety hazards. The requirements are designed to prevent offsite disturbances from gas and oil operations."

After a federal oil and gas lease is issued, the federal leaseholder cannot construct a road, drill a well or conduct ground disturbing operations until the federal government reviews and approves plans for each proposed well and associated roads. Before ground disturbing operations can occur, the leaseholder must submit an Application for Permit to Drill, including a surface use plan of operations, for review and approval by the federal government (BLM and Forest Service). The APD includes a Drilling Plan and a Surface Use Plan of Operations. The Drilling Plan includes specific information concerning the drilling, casing and cementing programs. The applicant's proposal for use of the surface is provided in the Surface Use Plan of Operations. This plan includes the applicant's proposed access road location and design, proposed well sites, pipelines, and other facilities, waste disposal, plans for surface reclamation, and any other required information for conducting an environmental analysis of the APD. Prior to filing an APD, the applicant may choose to file a Notice of Staking (NOS) in order to begin early coordination with the Surface Management Agency (Forest Service). The Forest Service, in cooperation with the BLM, conducts an environmental analysis of the proposed operation under the National Environmental Policy Act of 1969 (NEPA). Public involvement is an integral part of the environmental analysis for the APD. Alternatives, such as different access roads locations, are assessed to address public issues. Based on the environmental analysis, mitigating measures for environmental protection are developed and become "conditions of approval" if the surface use plan of operations and APD are approved. Upon completion of the NEPA analysis and documentation, the Forest Service will complete a decision document pertaining to the approval/disapproval of the Surface Use Plan of Operations and the BLM will complete a decision document for approval/disapproval of the APD.

Consent to leasing with standard lease terms provides the leases terms as well as federal regulations to 1) control surface use of proposed activities in the lease area, and 2) prohibit surface occupancy on certain areas within the lease area. For example, a proposed oil and gas facility, such as a road, can be relocated up to 200 meters without any additional stipulation. As a result, the Forest Service can identify and enforce limited areas of no surface occupancy within a standard lease without any additional stipulation. Under a standard lease the Forest Service can prohibit or control occupancy of riparian areas as needed, without any additional stipulation. Under a standard lease, the Forest Service can apply the Endangered Species Act to identify and enforce areas of no surface occupancy of any size acreage, when justified, within a standard lease without any additional stipulation. But when such restrictions cover all or a substantial portion of the lease and are known in advance before leasing, then it is appropriate to attach an additional stipulation to the lease to notify potential bidders. Potential bidders need this information in order to submit informed bids on federal oil and gas leases. The Federal Onshore Oil and Gas Leasing Reform Act of 1987 requires that all federal oil and gas leases be subject to competitive bidding. In the eastern United States, the Bureau of Land Management (BLM), Eastern States Office (ESO), holds lease sales quarterly.

2) CONSENT WITH ADDITIONAL STIPULATIONS INCLUDES PRIMARILY THE CONTROLLED SURFACE USE STIPULATION. The Controlled Surface Use (CSU) Stipulation is intended to be used when occupancy and use are generally allowed on all or portions of the lease area year-round, but restrictions or controls are necessary for specific types of activities rather than all activity. For example, road construction in a 1,000 acres area of rugged terrain may be permitted only if the APD applicant conducts engineering geologic studies and submits road location and design data showing adequate treatment of potential slope stability concerns. If the APD applicant conducts the studies and submits the data, but the

Forest Service determines that potential slope stability concerns were not adequately treated, then the Forest Service would not approve road construction in the 1,000-acre area of the lease.

Consent with additional stipulations may include a Timing Limitation. The Timing Limitation (sometimes called Seasonal Stipulation) prohibits oil and gas exploration and development activities for time periods less than yearlong. A timing stipulation is not necessary if the time limitation involves the prohibition of new surface disturbing operations for periods of less than 60 days (43 CFR 3101.1-2).

3) THE NO SURFACE OCCUPANCY (NSO) STIPULATION is intended for use only when other stipulations are determined insufficient to adequately protect the public interest. A No Surface Occupancy Stipulation is not needed if the desired protection would not require relocation of proposed operations by more than 200 meters (43 CFR 3101.1-2). Alternatives E, G, and I have NSO Stipulations in inventoried roadless areas. Alternatives A, B, and D have NSO Stipulations in semi-primitive motorized and semi-primitive non-motorized portions of inventoried roadless areas.

Future Oil And Gas Exploration And Development

Congress passed a law in 1987 that updated and enlarged the Forest Service role and authority in administering surface operations for oil and gas development on National Forest System lands (Federal Onshore Oil and Gas Leasing Reform Act of 1987). The reasonably foreseeable development projected for the Revised Forest Plan was developed based on the law and the implementing regulations, including the 36 CFR 228E regulations for Forest Service review and approval of surface use plans of operations.

The reasonably foreseeable development includes an estimate of the number of wells, miles of access road and pipeline construction, and acres of clearing for well pads, access roads and pipelines. The development of new gas wells, access roads and associated facilities would occur over 15 years, which is the time span for the Revised Forest Plan. After construction of each well pad, the portion of the site not needed for operations would be reclaimed. Gas wells are projected to be in production for 30 years, after which the well pads and associated facilities would have final reclamation. Virginia's minimum well spacing is 2,500 feet. Given the rugged topography on the Forest, a well spacing of one-half mile is estimated for gas field development. Where a gas field is developed, the density of wells pad is estimated as one well pad for each 160 acres.

The level of oil and gas exploration and development can vary from low to moderate to high. When energy prices are low, then there may be low levels of exploration and development. When energy prices are high, then there may be high levels of exploration and development. The reasonably foreseeable development (number of wells, miles of access road, etc.) discussed here is for a high level of oil and gas exploration and development. The upsurge in proposed oil and gas development on federal leases in the Pine Mountain area since 2000 is an indication that the next 10 to 15 years will have much a higher level oil and gas development than the previous 15 years. A reasonably foreseeable development (number of wells, miles of access road, etc.) for a moderate level of development would be 50% of the high level. A reasonably foreseeable development (number of wells, miles of access road, etc.) for a low level of development would 25% of the high level.

Because of the difference in oil and gas potential between the Clinch Ranger District and the other Ranger Districts, the reasonably foreseeable development on federal oil and gas leases is discussed in two sections: first, the Clinch Ranger District, and secondly, the rest

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of the Forest. For the Clinch Ranger District, the reasonably foreseeable development on federal oil and gas leases varies by Alternative, and is displayed by Alternative by 5th level HUC watersheds (Table 3-188). All Alternatives are subject to existing federal oil and gas leases in effect at time of approval of Revised Forest Plan. The existing oil and gas leases, including leases held by production, are valid existing rights in place before the Revised Forest Plan is approved. As of June 2002, fourteen federal oil and gas leases were in effect on 14,979 acres of the Forest on the Clinch Ranger District, mostly in the Pine Mountain area (Figure 3-6). The reasonably foreseeable development includes substantial exploration and development on the Clinch Ranger District, including development on existing leases. When a lease expires after approval of Revised Forest Plan, then any new lease request would be subject to Revised Forest Plan's consent decision for new leases.

No well drilling is anticipated on the Mount Rogers National Recreation Area and Glenwood Ranger District, which have a low potential for oil and gas. For the New River Valley and New Castle Ranger Districts, the reasonably foreseeable development on federal oil and gas leases is a similar amount of exploration drilling for all Alternatives. One exploration well in decade 1 and one exploration well in decade two are estimated in each of the following 5th level HUC watersheds: 0208020103, 0208020108, 0505000108, 0505000110, 0505000202, 0505000203, 0601010101, and 0601010202.

These exploration wells are estimated to have less than a 10% probability of success. If exploration were successful, a small gas field (5 to 10 gas wells) might be developed.

The historic pattern of conventional gas production on the Forest is expected to continue. Based on this historic pattern and the geologic setting of the Forest, no large-scale coal bed methane development is expected on the Forest. Natural gas production off the Forest is expected to include both conventional gas and coal bed methane gas. State and federal agencies have environmental protection requirements for conventional gas and coal bed methane gas.

Cumulative Effects: Other future oil and gas exploration and development on and off the Forest

The effects of the future exploration and development from federal oil and gas leases will be in addition to the effects from past and present exploration and development from 1) federal oil and gas leasing on the Forest, 2) private oil and gas (outstanding and reserved mineral rights) on the Forest, and 3) oil and gas activity off the Forest. The past and present exploration and development from these three categories of oil and gas activity were discussed earlier in relation to fifth level HUC watersheds.

To these effects will also be added effects from future exploration and development private oil and gas (outstanding and reserved mineral rights) on the Forest. The Clinch Ranger District will have oil and gas development on federal surface underlain by private (reserved and outstanding) mineral rights over the 15 years of the Revised Forest Plan. Much of this development will be continued expansion of the South Coeburn natural gas field. For the Clinch Ranger District, the estimated development on reserved and outstanding mineral rights is displayed by Alternative by 5th level HUC watersheds (Table 3-189). For the other Ranger Districts outside the Clinch Ranger District, future exploration and development of private oil and gas (outstanding and reserved mineral rights) is not considered likely as part of the reasonably foreseeable development.

To these effects will also be added effects from future exploration and development of oil and gas off the Forest in the 5th level HUC watersheds containing NFS lands on the Clinch Ranger District. This off-Forest oil and gas development is estimated by 5th level HUC watersheds (Table 3-190). For the other Ranger Districts outside the Clinch Ranger District,

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Table 3-188. Reasonably Foreseeable Development on Federal Oil and Gas Leases on National Forest by Alternative by 5th Level HUC Watersheds on the Clinch Ranger District

HUC 0507020205	Alternative													
	A		B		D		E		F		G		I	
Decade	**1**	**2**	**1**	**2**	**1**	**2**	**1**	**2**	**1**	**2**	**1**	**2**	**1**	**2**
(a) number of federal wells drilled on NF	63	16	65	16	63	16	73	18	78	19	73	18	69	12
(b) construction of well sites (acres)	94	24	98	24	95	24	110	28	117	29	109	27	103	18
(c) acres reclaimed after drilling	63	16	65	16	63	16	73	18	78	19	73	18	69	12
(d) acres used for & reclaimed after operations	31	8	33	8	32	8	37	9	39	10	36	9	34	6
(f) access roads (miles)	31	8	33	8	32	8	37	9	39	10	36	9	34	6
(g) access roads (acres)	191	48	197	49	191	48	222	56	236	59	220	55	209	36
(I) pipeline outside road right-of-way (miles)	3.1	0.8	3.3	0.8	3.2	0.8	3.7	0.9	3.9	1	3.6	0.9	3.4	0.6
(j) pipeline outside road right-of-way (acres)	11.4	2.9	11.8	3	11.5	2.9	13.3	3.3	14.2	3.5	13.2	3.3	12.5	2.2
(k) reclamation of pipeline outside road (acres)	11.4	2.9	11.8	3	11.5	2.9	13.3	3.3	14.2	3.5	13.2	3.3	12.5	2.2
Subtotal: acres disturbed (b)+(g)+(j)	296	74	307	77	298	74	346	86	367	92	342	86	325	56
HUC 0601020504	**Alternative**													
	A		B		D		E		F		G		I	
Decade	**1**	**2**	**1**	**2**	**1**	**2**	**1**	**2**	**1**	**2**	**1**	**2**	**1**	**2**
(a) number of federal wells drilled on NF	5	3	7	3	7	3	6	3	8	4	7	3	7	3
(b) construction of well sites (acres)	8	4	10	5	10	5	8	4	12	6	10	5	10	5
(c) acres reclaimed after drilling	5	3	7	3	7	3	6	3	8	4	7	3	7	3
(d) acres used for & reclaimed after operations	3	1	3	2	3	2	3	1	4	2	3	2	3	2
(f) access roads (miles)	3	1	3	2	3	2	3	1	4	2	3	2	3	2
(g) access roads (acres)	17	8	21	10	21	10	17	8	23	12	20	10	20	10
(I) pipeline outside road right-of-way (miles)	0.3	0.1	0.3	0.2	0.3	0.2	0.3	0.1	0.4	0.2	0.3	0.2	0.3	0.2
(j) pipeline outside road right-of-way (acres)	1	0.5	1.2	0.6	1.2	0.6	1	0.5	1.4	0.7	1.2	0.6	1.2	0.6
(k) reclamation of pipeline outside road (acres)	1	0.5	1.2	0.6	1.2	0.6	1	0.5	1.4	0.7	1.2	0.6	1.2	0.6
Subtotal: acres disturbed (b)+(g)+(j)	26	13	32	16	32	16	26	13	36	18	31	15	31	15

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Table 3-188 Cont'd. Reasonably Foreseeable Development on Federal Oil and Gas Leases on National Forest by Alternative by 5th Level HUC Watersheds on the Clinch Ranger District

HUC 0601020505	Alternative													
	A		B		D		E		F		G		I	
Decade	**1**	**2**	**1**	**2**	**1**	**2**	**1**	**2**	**1**	**2**	**1**	**2**	**1**	**2**
(a) number of federal wells drilled on NF	5	3	6	3	6	3	4	2	7	3	4	2	6	3
(b) construction of well sites (acres)	8	4	8	4	9	4	6	3	10	5	6	3	9	4
(c) acres reclaimed after drilling	5	3	6	3	6	3	4	2	7	3	4	2	6	3
(d) acres used for & reclaimed after operations	3	1	3	1	3	1	2	1	3	2	2	1	3	1
(f) access roads (miles)	3	1	3	1	3	1	2	1	3	2	2	1	3	1
(g) access roads (acres)	17	8	17	8	18	9	12	6	20	10	11	6	17	9
(I) pipeline outside road right-of-way (miles)	0.3	0.1	0.3	0.1	0.3	0.1	0.2	0.1	0.3	0.2	0.2	0.1	0.3	0.1
(j) pipeline outside road right-of-way (acres)	1	0.5	1	0.5	1.1	0.5	0.7	0.4	1.2	0.6	0.7	0.3	1	0.5
(k) reclamation of pipeline outside road (acres)	1	0.5	1	0.5	1.1	0.5	0.7	0.4	1.2	0.6	0.7	0.3	1	0.5
Subtotal: acres disturbed (b)+(g)+(j)	26	13	26	13	28	14	19	9	32	16	18	9	27	13
HUC 0601020601	**Alternative**													
	A		**B**		**D**		**E**		**F**		**G**		**I**	
Decade	**1**	**2**	**1**	**2**	**1**	**2**	**1**	**2**	**1**	**2**	**1**	**2**	**1**	**2**
(a) number of federal wells drilled on NF	10	5	13	6	8	4	5	2	16	8	7	3	7	3
(b) construction of well sites (acres)	14	7	20	10	12	6	7	3	23	12	10	5	10	5
(c) acres reclaimed after drilling	10	5	13	6	8	4	5	2	16	8	7	3	7	3
(d) acres used for & reclaimed after operations	5	2	7	3	4	2	2	1	8	4	3	2	3	2
(f) access roads (miles)	5	2	7	3	4	2	2	1	8	4	3	2	3	2
(g) access roads (acres)	29	14	39	19	25	12	14	7	47	23	21	10	20	10
(I) pipeline outside road right-of-way (miles)	0.5	0.2	0.7	0.3	0.4	0.2	0.2	0.1	0.8	0.4	0.3	0.2	0.3	0.2
(j) pipeline outside road right-of-way (acres)	1.7	0.9	2.4	1.2	1.5	0.7	0.8	0.4	2.8	1.4	1.3	0.6	1.2	0.6
(k) reclamation of pipeline outside road (acres)	1.7	0.9	2.4	1.2	1.5	0.7	0.8	0.4	2.8	1.4	1.3	0.6	1.2	0.6
Subtotal: acres disturbed (b)+(g)+(j)	45	22	61	30	39	19	22	11	73	36	33	16	31	15

Table 3-188 Cont'd. Reasonably Foreseeable Development on Federal Oil and Gas Leases on National Forest by Alternative by 5th Level HUC Watersheds on the Clinch Ranger District

HUC 0507020203	Alternative													
	A		B		D		E		F		G		I	
Decade	**1**	**2**	**1**	**2**	**1**	**2**	**1**	**2**	**1**	**2**	**1**	**2**	**1**	**2**
(a) number of federal wells drilled on NF	1	1	1	1	1	1	1	1	1	1	1	1	1	1
(b) construction of well sites (acres)	1.5	1.5	1.5	1.5	1.5	1.5	1.5	1.5	1.5	1.5	1.5	1.5	1.5	1.5
(c) acres reclaimed after drilling	1	1	1	1	1	1	1	1	1	1	1	1	1	1
(d) acres used for & reclaimed after operations	0.5	0.5	0.5	0.5	0.5	0.5	0.5	0.5	0.5	0.5	0.5	0.5	0.5	0.5
(f) access roads (miles)	0.5	0.5	0.5	0.5	0.5	0.5	0.5	0.5	0.5	0.5	0.5	0.5	0.5	0.5
(g) access roads (acres)	3	3	3	3	3	3	3	3	3	3	3	3	3	3
(l) pipeline outside road right-of-way (miles)	0.1	0.1	0.1	0.1	0.1	0.1	0.1	0.1	0.1	0.1	0.1	0.1	0.1	0.1
(j) pipeline outside road right-of-way (acres)	0.2	0.2	0.2	0.2	0.2	0.2	0.2	0.2	0.2	0.2	0.2	0.2	0.2	0.2
(k) reclamation of pipeline outside road (acres)	0.2	0.2	0.2	0.2	0.2	0.2	0.2	0.2	0.2	0.2	0.2	0.2	0.2	0.2
Subtotal: acres disturbed (b)+(g)+(j)	5	5	5	5	5	5	5	5	5	5	5	5	5	5

Assumptions for federal oil and gas wells on National Forest:

acres cleared for each well site	1.5
acres of each well site reclaimed after drilling	1
acres of each well site used for operations	0.5
length of access road constructed to each federal well with pipeline in right-of-way (feet)	2,640
width of road clearing (feet)	50
length of pipeline constructed outside road right-of-way (percent of road length)	10%
width of pipeline clearing constructed outside road right-of-way (feet)	30
time period for well operation and production (years)	30

Table 3-189. Reasonably Foreseeable Development of Private Oil and Gas Wells (outstanding/reserved mineral rights) on National Forest by Alternative by 5th Level HUC Watershed on the Clinch Ranger District

HUC 0507020205	Alternative													
	A		B		D		E		F		G		I	
Decade	**1**	**2**	**1**	**2**	**1**	**2**	**1**	**2**	**1**	**2**	**1**	**2**	**1**	**2**
(a) number of private wells drilled on NF	1.9	4.8	1.1	5.5	1.1	5.5	5.5	1.9	5.54	2.7	2.2	1	4	1.2
(b) construction of well sites (acres)	2.9	7.3	1.7	8.2	1.6	8.2	8.2	2.8	8.31	4.1	3.3	1.5	6	1.8
(c) acres reclaimed after drilling	1.9	4.8	1.1	5.5	1.1	5.5	5.5	1.9	5.54	2.7	2.2	1	4	1.2
(d) acres used for & reclaimed after operations	1	2.4	0.6	2.7	0.5	2.7	2.7	0.9	2.77	1.4	1.1	0.5	2	0.6
(f) access roads (miles)	1	2.4	0.6	2.7	0.5	2.7	2.7	0.9	2.77	1.4	1.1	0.5	2	0.6
(g) access roads (acres)	5.8	15	3.4	17	3.3	17	17	5.7	16.8	8.3	6.7	3	12	3.6
(l) pipeline outside road right-of-way (miles)	0.1	0.2	0.1	0.3	0.1	0.3	0.3	0.1	0.28	0.1	0.1	0.1	0.2	0.1
(j) pipeline outside road right-of-way (acres)	0.3	0.9	0.2	1	0.2	1	1	0.3	1.01	0.5	0.4	0.2	0.7	0.2
(k) reclamation of pipeline outside road (acres)	0.3	0.9	0.2	1	0.2	1	1	0.3	1.01	0.5	0.4	0.2	0.7	0.2
Subtotal: acres disturbed (b)+(g)+(j)	9	23	5.3	26	5.2	26	26	8.9	26.1	13	10	4.7	19	5.6
HUC 0601020504	**Alternative**													
	A		B		D		E		F		G		I	
Decade	**1**	**2**	**1**	**2**	**1**	**2**	**1**	**2**	**1**	**2**	**1**	**2**	**1**	**2**
(a) number of private wells drilled on NF	69	34	75	37	76	37	67	33	79.5	39	71	35	72	35
(b) construction of well sites (acres)	103	51	113	55	114	56	101	50	119	59	106	52	108	53
(c) acres reclaimed after drilling	69	34	75	37	76	37	67	33	79.5	39	71	35	72	35
(d) acres used for & reclaimed after operations	34	17	38	18	38	19	34	17	39.8	20	35	17	36	18
(f) access roads (miles)	34	17	38	18	38	19	34	17	39.8	20	35	17	36	18
(g) access roads (acres)	209	103	227	112	230	113	203	100	241	119	215	106	217	107
(l) pipeline outside road right-of-way (miles)	3.4	1.7	3.8	1.8	3.8	1.9	3.4	1.7	3.98	2	3.5	1.7	3.6	1.8
(j) pipeline outside road right-of-way (acres)	13	6.2	14	6.7	14	6.8	12	6	14.5	7.1	13	6.4	13	6.4
(k) reclamation of pipeline outside road (acres)	13	6.2	14	6.7	14	6.8	12	6	14.5	7.1	13	6.4	13	6.4
Subtotal: acres disturbed (b)+(g)+(j)	325	160	354	174	357	176	316	156	375	185	334	165	338	167

Assumptions for private oil and gas wells (outstanding/reserved mineral rights) on National Forest:

acres cleared for each well site	1.5
acres of each well site reclaimed after drilling	1.0
acres of each well site used for operations	1
length of access road constructed to each private well with pipeline in right-of-way (feet)	1,320
width of road clearing (feet)	50%
length of pipeline constructed outside road right-of-way (percent of road length)	0
width of pipeline clearing constructed outside road right-of-way (feet)	30
time period for well operation and production (years)	30

Table 3-189 Cont'd. Reasonably Foreseeable Development of Private Oil and Gas Wells (outstanding/reserved mineral rights) on National Forest by Alternative by 5th Level HUC Watershed on the Clinch Ranger District

HUC 0601020505	Alternative													
	A		B		D		E		F		G		I	
Decade	**1**	**2**	**1**	**2**	**1**	**2**	**1**	**2**	**1**	**2**	**1**	**2**	**1**	**2**
(a) number of private wells drilled on NF	14	6.7	14	6.7	14	6.7	14	6.7	15.1	7.4	14	6.7	14	6.7
(b) construction of well sites (acres)	20	10	20	10	20	10	20	10	22.6	11	20	10	20	10
(c) acres reclaimed after drilling	14	6.7	14	6.7	14	6.7	14	6.7	15.1	7.4	14	6.7	14	6.7
(d) acres used for & reclaimed after operations	6.8	3.3	6.8	3.3	6.8	3.3	6.8	3.3	7.55	3.7	6.8	3.3	6.8	3.3
(f) access roads (miles)	6.8	3.3	6.8	3.3	6.8	3.3	6.8	3.3	7.55	3.7	6.8	3.3	6.8	3.3
(g) access roads (acres)	41	20	41	20	41	20	41	20	45.7	23	41	20	41	20
(l) pipeline outside road right-of-way (miles)	0.7	0.3	0.7	0.3	0.7	0.3	0.7	0.3	0.75	0.4	0.7	0.3	0.7	0.3
(j) pipeline outside road right-of-way (acres)	2.5	1.2	2.5	1.2	2.5	1.2	2.5	1.2	2.74	1.4	2.5	1.2	2.5	1.2
(k) reclamation of pipeline outside road (acres)	2.5	1.2	2.5	1.2	2.5	1.2	2.5	1.2	2.74	1.4	2.5	1.2	2.5	1.2
Subtotal: acres disturbed (b)+(g)+(j)	64	32	64	32	64	32	64	32	71.1	35	64	32	64	32

HUC 0601020601	Alternative													
	A		B		D		E		F		G		I	
Decade	**1**	**2**	**1**	**2**	**1**	**2**	**1**	**2**	**1**	**2**	**1**	**2**	**1**	**2**
(a) number of private wells drilled on NF	15	7.3	16	8	16	8	15	7.5	20.7	10	13	6.5	15	7.4
(b) construction of well sites (acres)	22	11	24	12	24	12	23	11	31	15	20	9.8	23	11
(c) acres reclaimed after drilling	15	7.3	16	8	16	8	15	7.5	20.7	10	13	6.5	15	7.4
(d) acres used for & reclaimed after operations	7.4	3.7	8.1	4	8.1	4	7.6	3.7	10.3	5.1	6.6	3.3	7.5	3.7
(f) access roads (miles)	7.4	3.7	8.1	4	8.1	4	7.6	3.7	10.3	5.1	6.6	3.3	7.5	3.7
(g) access roads (acres)	45	22	49	24	49	24	46	23	62.7	31	40	20	46	22
(l) pipeline outside road right-of-way (miles)	0.7	0.4	0.8	0.4	0.8	0.4	0.8	0.4	1.03	0.5	0.7	0.3	0.8	0.4
(j) pipeline outside road right-of-way (acres)	2.7	1.3	3	1.5	3	1.5	2.8	1.4	3.76	1.9	2.4	1.2	2.7	1.3
(k) reclamation of pipeline outside road (acres)	2.7	1.3	3	1.5	3	1.5	2.8	1.4	3.76	1.9	2.4	1.2	2.7	1.3
Subtotal: acres disturbed (b)+(g)+(j)	70	35	77	38	77	38	72	35	97.4	48	63	31	71	35

HUC 0507020203	Alternative													
	A		B		D		E		F		G		I	
Decade	**1**	**2**	**1**	**2**	**1**	**2**	**1**	**2**	**1**	**2**	**1**	**2**	**1**	**2**
(a) number of private wells drilled on NF	0	0	0	0	0	0	0	0	0	0	0	0	0	0

Table 3-190. Reasonably Foreseeable Development of Oil and Gas Wells off the National Forest by Alternative by 5th Level HUC Watersheds on the Clinch Ranger District

	Alternative													
	A		B		D		E		F		G		I	
Decade	**1**	**2**	**1**	**2**	**1**	**2**	**1**	**2**	**1**	**2**	**1**	**2**	**1**	**2**
HUC 0507020205														
number of wells drilled off the National Forest	150	100	150	100	150	100	150	100	150	100	150	100	150	100
acres disturbed by wells off the National Forest	600	400	600	400	600	400	600	400	600	400	600	400	600	400
HUC 0601020504														
number of wells drilled off the National Forest	80	80	80	80	80	80	80	80	80	80	80	80	80	80
acres disturbed by wells off the National Forest	320	320	320	320	320	320	320	320	320	320	320	320	320	320
HUC 0601020505														
number of wells drilled off the National Forest	10	10	10	10	10	10	10	10	10	10	10	10	10	10
acres disturbed by wells off the National Forest	40	40	40	40	40	40	40	40	40	40	40	40	40	40
HUC 0601020601														
number of wells drilled off the National Forest	70	70	70	70	70	70	70	70	70	70	70	70	70	70
acres disturbed by wells off the National Forest	280	280	280	280	280	280	280	280	280	280	280	280	280	280
HUC 0507020203														
number of wells drilled off the National Forest	200	100	200	100	200	100	200	100	200	100	200	100	200	100
acres disturbed by wells off the National Forest	800	400	800	400	800	400	800	400	800	400	800	400	800	400

the future exploration and development off the Forest in the 5th level HUC watersheds containing NFS lands is projected to be similar to the estimate made for federal leasing in those 5th level HUC watersheds.

Direct, Indirect and Cumulative Effects of Federal Oil and Gas Leasing Availability and Consent

AIR QUALITY

The Jefferson National Forest is assessing the environmental consequences of leasing natural gas exploration and production rights on the Clinch District of the Forest, under a variety of Alternatives. The primary criteria pollutant emissions from development of natural gas wells are nitrogen oxides (NO_x) and volatile organic compounds (VOC). These pollutants combine in the presence of sunlight to form ozone, a regulated pollutant that affects human health, and vegetation. The purpose of this analysis is to examine potential air quality impacts of emissions from the proposed activities.

Air quality impacts from development of a natural gas field can be divided into two categories: construction of well sites and production/operation of the wells. These activities differ in that the construction phase is relatively short, while the production phase will persist as long as the well continues to produce gas.

Construction Emissions: Construction emissions include the pollutant emissions from well pad development, which involves three separate, sequential activities: 1) Clearing, grading and construction of the road that connects the existing access road to the well pad site. These activities are sources of fugitive dust emissions from the construction traffic over unpaved roads, and tailpipe emissions from the construction traffic. 2) Rig-up, drilling and rig-down. These activities consist of bringing equipment and supplies by truck to the well site, drilling a hole to the desired depth, and removing the drilling equipment. Pollutant emissions from this phase of activity include particulates from the traffic on unpaved roads, tailpipe emissions from trucks, and exhaust emissions from the diesel powered drilling engines. 3) Completion and testing involves running pipe into the borehole and flaring small quantities of gas at the surface to evaluate productivity of the well. Pollutant emissions that occur during completion and testing include road dust from truck traffic, tailpipe emissions from the trucks, and products of combustion from flaring natural gas. It was assumed that each well would require construction of a separate well pad. Total construction emissions were calculated for each year, based on the projections for number wells to be constructed.

Production Emissions: Gas produced from leased wells on the Forest will be collected and piped to a compressor station located on private land. The main source of emissions from the production phase will be from fugitive equipment emissions. Lesser emissions come from the heater-separator that is designed to separate liquids from the gas stream. Heat comes from burning some of the methane produced from the well.

The emission rates for construction and production activities have been taken from a Bureau of Land Management report "Environmental Assessment: Cooper Reservoir Natural Gas Development Project - Cumulative Air Quality Impact Analysis, May 1998". The Cooper Reservoir Project activities were similar to what would occur in gas field development in southwestern Virginia, which made it possible to use the pre-calculated, construction phase emissions for this analysis. Activities were of similar duration, similar equipment was used, and both projects involved "sweet" gas. Sweet gas wells do not produce hydrogen sulfide gas during flaring.

Analysis: Each Alternative has a specified maximum number of wells that could be put into production over the next two decades. The emissions from construction and operation of the reasonably foreseeable development scenario on the Forest are calculated and compared between Alternatives for the “Direct/Indirect Effects” analysis. Future emissions from private wells on national forest system lands and wells off-Forest are added to the emissions from the Direct/Indirect effects analysis to assess "Cumulative Effects". Projected emissions are then compared to the current emission inventory (existing area and point sources of pollution, EPA 1999) for a four-county analysis area to estimate the future potential effect on air quality. The analysis area included counties the Clinch District intersects: Dickenson, Lee, Scott and Wise.

Nitrogen oxide emissions are the primary emissions from the construction phase, and volatile organic compounds are the primary emissions from producing gas wells. Annual emissions of these pollutants were calculated based on projections of number of wells developed each year over a 30-year period. Construction emissions were calculated and included only in the year the well was developed. Production emissions were included in the total emissions calculated for the year the well was constructed and in all years following, to the end of the 30-year period. It was assumed that all wells developed would produce gas over the remainder of the 30-year analysis period. This results in increasing emissions over time, as incremental development of wells occurs. The range of annual emissions that could be produced over the analysis period is represented by a minimum and maximum value for each Alternative.

Direct/Indirect Effects: The direct effect, on air quality, of leasing national forest land for gas development will be to increase volatile organic compounds and nitrogen oxide in the atmosphere by a relatively small amount (Table 3-191). Annual emissions from “leased wells” in the reasonably foreseeable development scenario would contribute a maximum of 367 tons per year of VOC; about 5% of current emissions in the analysis area (7,140 tons). Nitrogen oxide emissions are much less (maximum of 71 tons per year), only 1% of current emissions (6,662 tons).

Table 3-191. Range of estimated air pollution emissions from projected gas well development on, and near, the Clinch District

	Direct Effects				Cumulative Effects			
	Range of Annual Volatile Organic Compound Emissions (tons)		Range of Annual Nitrogen Oxide Emissions (tons)		Range of Annual Volatile Organic Compound Emissions (tons)		Range of Annual Nitrogen Oxide Emissions (tons)	
Alternative	**Min**	**Max**	**Min**	**Max**	**Min**	**Max**	**Min**	**Max**
A	27	331	30	64	222	3,886	244	623
B	29	361	32	70	227	3,949	249	632
C	30	367	33	71	227	3,943	249	631
D	27	337	30	66	225	3,931	247	630
E	28	343	31	67	224	3,892	246	624
F	29	343	37	71	231	3,985	259	638
G	29	355	32	68	225	3,919	247	628
I	28	331	31	62	225	3,895	247	624
Current Emissions (EPA 1999 Emissions Inventory)					7,140 tons per year		6,662 tons per year	

There is essentially no difference in air pollution emissions between Alternatives. This is because the number of wells developed under each Alternative is about the same. For any Alternative emissions start off small at about 30 tons per year NOx and VOC in year 1 of development, the year of minimum emissions. New wells are constructed each year for the first fifteen years of the analysis and emissions increase as the gas field is developed and more wells become productive. Emissions level off at year 15, when construction is completed. Emissions in year 15 represent the maximum emissions over the planning period. Between years 21 and 30 emissions remain stable, reflecting only production from existing wells. After 30 years, emissions will begin to decline as wells are taken out of production.

Cumulative Effects: The cumulative effects air analysis included emissions from 1) wells that will be developed from existing leasing rights on national forest land, 2) private-rights wells on national forest land, 3) gas wells off-Forest, and those projected in the “reasonably foreseeable development scenario”, in the same four-county analysis area. Development of gas wells on the national forest occurs in the first 15 years of the analysis. New wells continue to be developed off-Forest in the final 15 years of the analysis. Projected emissions from all wells that could be developed in the four-county area are displayed in Table 3-191 as "Cumulative Effects". Cumulatively, emissions from all projected development could equal about 50% of current VOC emissions inventoried, and about 10% of nitrogen oxides. However, the emissions from leased gas wells on Forest Service land would contribute less than 10% of the cumulative emissions for VOCs, and about 11% for NOx. As stated above, these percentages are even less when compared to the current 1999 EPA emissions inventory. Both VOC and NOx contribute to the formation of ozone, a criteria pollutant monitored by state air regulators. There is no ozone monitoring within the analysis area and the nearest ozone non-attainment area is on the Mount Rogers National Recreation Area (the portion of Whitetop Mountain in Smyth County above 4500 feet). It is possible that Bristol, VA could be designated non-attainment for ozone in the future, as it is part of the Johnson City, Kingsport, Bristol Metropolitan Statistical Area that has data showing high ozone concentrations. However, it is unlikely that future designations of non-attainment will include the area where gas development may take place.

For general information on air quality regulations and current air quality on the Forest see the Affected Environment: Air section of the EIS.

HYDROLOGY

The Reasonably Foreseeable Development (RDF) for federal oil and gas on the Jefferson National Forest is concentrated on the Clinch Ranger District. The Clinch District includes parts of seven fifth code HUC watersheds, five of which have potential for future oil and gas development. These are: 05070202030, 05070202050, 06010205040, 06010205050, and 06010206010. National forest system lands within watershed 050130101010 contain a no surface occupancy stipulation under all alternatives. Watershed 05070202060 contains only 135 acres of NFS lands and no projected wells or other associated development. Other watersheds that have a minor possibility of reasonably foreseeable development are 02080201030, 02080201080, 05050001080, 05050001100, 05050002020, 05050002030, 06010101010, and 06010102020.

The physical effects of oil and gas leasing include erosion and sedimentation. Soil disturbing activities include construction or reconstruction of access roads, clearing and leveling of drill pad sites, and construction of pipelines. Site access is developed by building a new road or improving an existing one. Surface disturbance from road construction would be greater on steep slopes due to longer cut-and-fill slopes. Well sites are cleared and a level pad is constructed of sufficient size to set up the drilling rig and store pipes, compressors, and other equipment. Topography and the anticipated well depth strongly influence site size. Potential impacts of erosion and sedimentation are greatest during the construction phase. Implementing soil and water protection measures that are included in all operating plans can mitigate many of these impacts.

ANNUAL SEDIMENT YIELDS

The existing annual sediment yield of a watershed provides an indication of its current condition. When annual sediment yield is expressed as a unit value (tons per square mile), watersheds may be compared with one another. Sediment yields were estimated using a Geographic Information Systems (GIS) procedure described in the process paper Sediment Yields and Cumulative Effects for Water Quality and Associated Beneficial Uses. The procedure models erosion spatially on a 30 meter grid based on factors including land use, slope class, and physiographic zone, and routes the erosion value to the mouth of the fifth code HUC watersheds as annual sediment load in tons. This value is divided by the watershed area in square miles and for the Clinch watersheds is displayed in Figure 3-7. To place these values in perspective, small fully forested watersheds in the eastern United States have an average annual sediment yield of approximately 50 tons per square mile per year (Patric et al. 1984). Increases above this are attributable to nonforest land uses as identified in the GIS layers used in the model.

SOCIAL AND ECONOMIC DEVELOPMENT

MINERAL RESOURCES

FEDERAL OIL AND GAS REASONABLY FORESEEABLE DEVELOPMENT SCENARIO (RFD)

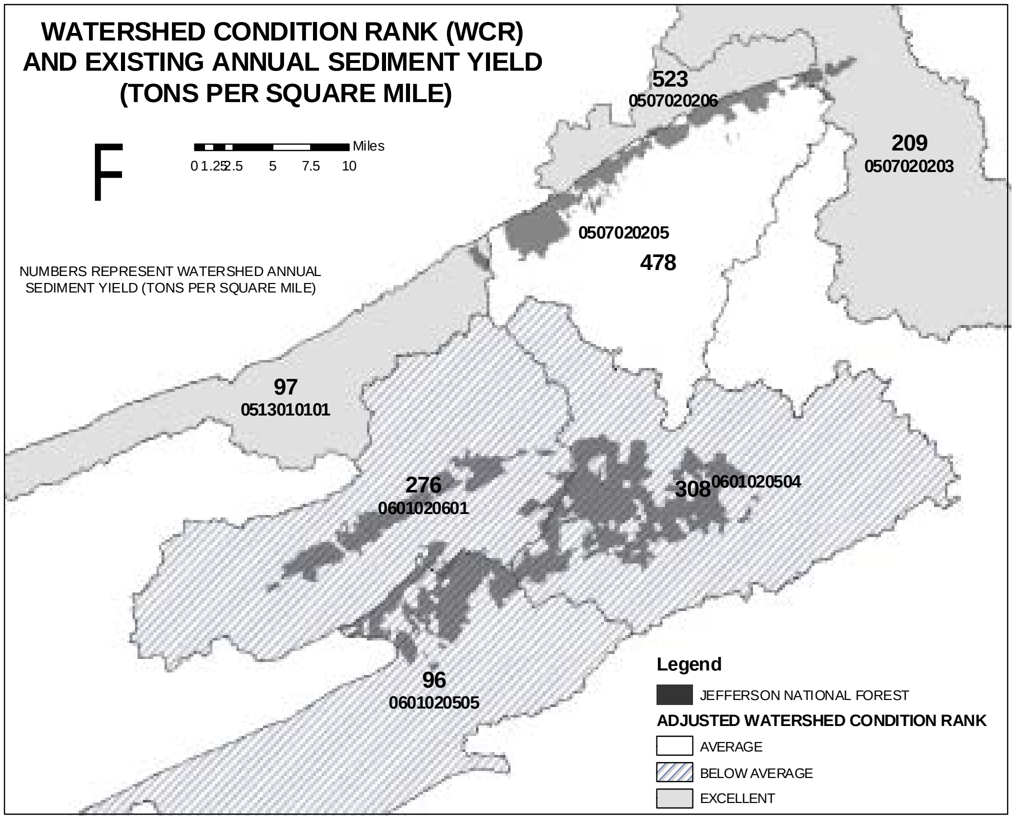

Figure 3-7. Watershed Condition Rank (WCR) and Existing Sediment Yield (tons per square mile per year). The 10-digit number is the Hydrologic Unit Code. The two or three digit number is the annual sediment yield in tons per square mile.

WATERSHED CONDITION RANK

Watershed Condition Rank (WCR) is used to characterize the condition of 5th level watersheds with respect to current sediment yields. The procedure for determining WCR is contained in the process paper *Sediment Yields and Cumulative Effects for Water Quality and Associated Beneficial Uses*.

In order to establish WCR's the current sediment average annual yield is determined and expressed as a percent above the baseline condition. Initial watershed health is determined by using the relative abundance of locally adapted species with respect to sediment increases. 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 (E), average (A), and below average (BA). In general, watersheds with the lowest annual sediment yields were ranked as excellent. Those with higher annual sediment yields ranked as average or below average. The exceptions were some watershed within the Cumberland Plateau provinces where condition thresholds allowed higher sediment yields. As discussed under the Water section, the initial WCR outcomes were validated and adjusted. Three of the fifth code HUC watersheds with oil and gas potential required adjustment. These were the Clinch-Guest (06010205040), the lower Clinch (06010205050) and the Powell River (06010606010). The current adjusted WCR rankings are displayed in Table 3-194.

SEDIMENT

A direct effect of implementation of the various alternatives is an increase in sediment yield from the watersheds as a result of activity related soil disturbance. Table 3-192 displays the percent increases over existing sediment yields due to management activity on the Jefferson National Forest, including development for oil and gas as well as timber harvest, roads, and other soil disturbing activities. The percent increases represent the change for an average or normal year. The table shows that for all watersheds and all alternatives, the percent increases are less than 5 percent. Sediment increases of this small magnitude are well within the range of variability that occurs from year to year in a watershed, termed "interannual variability" (see Figure 3-3 and discussion under Water section). As such, the direct effects of oil and gas development are immeasurable and insignificant at the fifth level hydrologic unit code (HUC) watershed level.

Table 3-192. Percent Increase over Existing Sediment Yield for RFD due to Forest Service Management Activity during the First Decade

Fifth Code HUC Watershed	Percent Increase by Alternative						
	A	B	D	E	F	G	I
02080201030	1.61	0.85	1.93	0.66	1.01	0.24	1.91
02080201080	4.36	3.43	4.44	1.67	2.52	0.66	3.93
05050001080	0.39	0.78	0.50	0.14	0.19	0.27	0.56
05050001100	0.12	0.09	0.15	0.06	0.10	0.03	0.11
05050002020	0.77	0.82	1.05	0.39	0.63	0.43	0.71
05050002030	0.53	0.36	0.95	0.26	0.40	0.18	0.43
05070202030	0.02	0.02	0.05	0.01	0.05	0.00	0.01
05070202050	0.15	0.14	0.29	0.09	0.32	0.02	0.09
05070202060	0.01	0.00	0.01	0.00	0.01	0.00	0.00
05130101010	0.04	0.04	0.09	0.03	0.10	0.01	0.02
06010101010	0.31	0.38	0.40	0.14	0.21	0.05	0.21
06010102020	0.22	0.13	0.36	0.09	0.22	0.03	0.21
06010205040	0.35	0.35	0.66	0.21	0.74	0.04	0.18
06010205050	0.67	0.85	1.10	0.43	1.00	0.07	0.87
06010206010	0.20	0.23	0.38	0.12	0.41	0.02	0.12

Cumulative effects include those related to changes in the pattern of land use within the watersheds. Activities within each watershed and outside of the National Forest were included in the sediment model. Future activities were modeled by projecting current rates of land use change and urban growth. Table 3-193 displays the combined sediment increases from activity on both private and National Forest land. The average combined increase is less than 4 percent. Only one watershed has combined increases greater than 8 percent. That is the Poor Fork of the Cumberland with a modeled combined increase of 14 percent. These increases are well within the range of interannual variability. It would take at least 162 years of data to detect a 8 percent increase in sediment, and 53 years of data to detect a 14 percent increase. For all watersheds under consideration, the cumulative effects of the sediment increases are well within the range of interannual variability and for all practical purposes are not detectable.

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Table 3-193. Percent Increase over Existing Sediment Yield for RFD due to Activity on Both National Forest and Private Land in the First Decade

Fifth Code HUC Watershed	Percent Increase by Alternative						
	A	B	D	E	F	G	I
02080201030	6.11	5.35	6.43	5.16	5.51	4.74	6.41
02080201080	6.16	5.24	6.24	3.47	4.32	2.46	5.73
05050001080	1.10	1.49	1.21	0.85	0.90	0.98	1.27
05050001100	1.18	1.16	1.22	1.13	1.17	1.10	1.17
05050002020	2.39	2.43	2.66	2.00	2.24	2.04	2.32
05050002030	3.50	3.32	3.91	3.23	3.37	3.15	3.39
05070202030	5.66	5.66	5.69	5.65	5.69	5.64	5.65
05070202050	2.54	2.53	2.69	2.49	2.72	2.41	2.48
05070202060	4.32	4.32	4.32	4.31	4.32	4.31	4.31
05130101010	13.26	13.26	13.31	13.24	13.32	13.22	13.23
06010101010	3.00	3.07	3.09	2.82	2.90	2.74	2.90
06010102020	1.26	1.17	1.40	1.13	1.26	1.07	1.25
06010205040	2.70	2.70	3.02	2.56	3.10	2.39	2.53
06010205050	6.44	6.62	6.87	6.20	6.77	5.84	6.64
06010206010	3.38	3.41	3.57	3.30	3.60	3.21	3.30

WATERSHED CONDITIONS

The WCR sediment model evaluated baseline sediment, current sediment yield, and increases from activities on both National Forest and private lands for five decades into the future. The increases are interpreted in the context of effects on endemic fish. Model

Table 3-194. Watershed Health Index: Current and by Alternative for the First Decade. E = Excellent; A = Average; BA = Below Average

Fifth Code HUC Watershed	ADJUSTED WCR	WCR BY ALTERNATIVE						
		A	B	D	E	F	G	I
02080201030	E	E	E	E	E	E	E	E
02080201080	E	E	E	E	E	E	E	E
05050001080	BA	BA	BA	BA	BA	BA	BA	BA
05050001100	BA	BA	BA	BA	BA	BA	BA	BA
05050002020	A	A	A	A	A	A	A	A
05050002030	A	A	A	A	A	A	A	A
05070202030	E	E	E	E	E	E	E	E
05070202050	A	A	A	A	A	A	A	A
05070202060	E	E	E	E	E	E	E	E
05130101010	E	E	E	E	E	E	E	E
06010101010	A	A	A	A	A	A	A	A
06010102020	BA	BA	BA	BA	BA	BA	BA	BA
06010205040	BA	BA	BA	BA	BA	BA	BA	BA
06010205050	BA	BA	BA	BA	BA	BA	BA	BA
06010206010	BA	BA	BA	BA	BA	BA	BA	BA

outputs for current WCR were validated as described in the Water section using the Watershed Assessment and Evaluation procedure. Table 3-194 displays the projected WCR for each watershed for each alternative for the first decade. The WCR was modeled for each alternative for five decades. The data showed no change in the WCR and therefore no cumulative watershed effect for five decades into the future.

SOILS

Oil and gas development is likely to affect soils with displacement and compaction. Disturbed soils are prone to erosion due to vegetation removal. Soils could also be affected by localized spills of fluids used during the drilling process, which could sterilize the soil and prevent biomass production.

Table 3-195 shows how each alternative will impact long-term soil productivity and if these impacts will be significant. A significant impact to soil productivity will be a fifteen percent reduction in productivity. When long term soil productivity is reduced on fifteen percent or more of the treatment area by any alternative, then this would be a significant impact to the soil resource and would not be in compliance with the laws guiding FS policy on protecting soil productivity. By identifying impacts to soil productivity and minimizing these impacts to small areas, we can protect the soil's ability to function as an important part of the surrounding ecosystem.

Table 3-195. Impacts to Soil Productivity from RFD of Oil and Gas on Clinch Ranger District

	Alternative						
	A	B	D	E	F	G	I
Long-term effects to soil productivity from Federal lease development due to wells and roads (acres first 15 years)	332	353	336	344	435	355	331
Long-term effects to soil productivity from private lease development due to wells and roads (acres first 15 years)	459	492	496	453	544	450	467
Cumulative effects to soil productivity from lease development in first 15 years (acres) Long-term effects past and future	991	1055	1032	997	1179	1005	999
Cumulative effects to soil productivity from lease development on Federal minerals past and next 15 years, % of the Federal minerals estate on Clinch RD-Long-term effects	0.9%	1.0%	0.9%	0.9%	1.2%	1.0%	0.9%
Cumulative effects to soil productivity from all lease development on Clinch RD, past and next 15 years, % of the Federal and private minerals estate	1.1%	1.1%	1.1%	1.1%	1.3%	1.1%	1.1%

Most of the RFD for oil and gas is on the Clinch Ranger District. The table below displays the long-term effects to soil productivity in the areas where leasing and development will occur. Long-term effects will be due to well site construction and road building. Cumulative effects add in wells and roads already constructed on the Clinch RD for oil and gas development (75 well sites, 0.5 mile of road per site, 200 acres).

As shown in Table 3-195, all the alternatives are very similar in their impact to soil productivity on the Clinch Ranger District.

On the rest of the Jefferson National Forest in the next fifteen-year period, there could be an additional 16 well sites developed with an associated eight miles of road. This development would be spread out over eight different 5th Order (large) watersheds. Specific impacts would be the same for this as that discussed for the Clinch RD. Short-term effects from compaction and erosion will be mitigated through implementation of the site-specific erosion and sediment control plans developed for all construction areas. A Spill Prevention Control and Countermeasures Plan is prepared for each site to minimize the possibility and impacts from spills. Overall, cumulative long-term effects to soil productivity from RFD of oil and gas on the Jefferson NF appear to be well within guidelines for maintaining long-term soil productivity on the Forest.

GEOLOGIC RESOURCES

The geologic setting of the Forest is discussed in the Geology section of this EIS. This section will focus on potential impacts on geologic resources and geologic hazards from federal oil and gas on the Jefferson National Forest. Most oil and gas activity in the Reasonably Foreseeable Development (RFD) is concentrated on the Clinch Ranger District. On the remainder of the Forest the RFD includes scattered oil and gas activity on the New River Valley and New Castle Ranger Districts.

Federal oil and gas activities, such as drilling and well plugging, can have potential effects on groundwater. Improper casing and cementing of the well bore could cause contamination of groundwater. Federal and State regulations to protect groundwater, for example by sealing off water aquifers, are standard requirements in oil and gas exploration and development. All federal oil and gas leases have lease terms requiring the lessee to conduct operations in a manner that minimizes potential effects to water resources. A federal lessee cannot drill any well or conduct ground disturbing operations until the federal government reviews and approves drilling plans for each proposed well. The lessee must submit an Application for Permit to Drill (APD) to the BLM and Forest Service. The APD includes a Drilling Plan and a Surface Use Plan of Operations. The Drilling Plan includes the lessee’s proposed drilling, casing and cementing plans to protect groundwater. The federal government (BLM and Forest Service) conducts an environmental analysis of the proposed APD, including drilling plans. Public involvement is an integral part of the environmental analysis. Based on the review and assessment of the proposed drilling plan, any additional mitigating measures for groundwater protection are included in the conditions of approval for the APD. When oil and gas wells are to be plugged and abandoned, the BLM reviews the operator’s well plugging plan to insure that the plan includes measures to protect groundwater. The federal government has inspection and enforcement to insure compliance with drill plans and well plugging plans. State government also requires operators to obtain a permit before drilling an oil and gas well. The State government, like the federal government, reviews proposed drilling plans and requires measures to protect groundwater. Although no large coal bed methane development is foreseen on the National Forest, the federal and state regulations, requirements, review and conditions of approval provide groundwater and environmental protections in regard to coal bed methane wells as well as conventional wells. Both the state and the federal government can decide not to approve any operation, whether for coal bed methane or conventional gas, that does not provide groundwater and other environmental protections. Based on the reviews of drilling plans for each proposed well for measures to protect groundwater, the effects on groundwater from federal oil and gas leasing are expected to be small. Using the number of wells drilled as an indicator of potential to affect groundwater, the potential effect is indicated by the number of wells in each Alternative displayed by 5th level HUC watersheds on Clinch Ranger District in Table 3-188 "Reasonably foreseeable development on federal oil and gas leases on National Forest by Alternative by 5th level HUC watersheds on Clinch Ranger District." For the remainder of the Forest, for all Alternatives, the potential impact for New River Valley and New Castle Ranger Districts is indicated by the estimated two wells in each of the following 5th level HUC watersheds: 0208020103, 0208020108, 0505000108, 0505000110, 0505000202, 0505000203, 0601010101, and 0601010202.

Spills of petroleum products, saline or produced waters, chemicals and hazardous materials have the potential to effect surface waters, groundwater, aquatic resources, vegetation and other surface resources. Proposed drilling plans and operating plans are reviewed to include measures to avoid spills and to insure contingency plans for spills. Because the Forest would be developing natural gas fields, and because produced waters are expected to be relatively small quantities, the potential for spills is reduced compared to a typical oil field with saline waters. Hazardous materials are transported off the Forest and disposed at EPA-approved disposal sites. The potential for spills is greatest during the drilling operations that may last one to three weeks for each well. Spills may occur during the production phase, but berms are designed to contain spills. Federal and State regulations require contingency plans for spills of hazardous materials.

Federal oil and gas activities in karst areas or areas that drain into karst could affect karst resources such as caves and sinkholes. Road construction and drilling could result in physical changes or damage to karst features. Road construction and other ground disturbing activities could increase the sediment that is transported naturally into sinkholes. Oil and gas activities could result in groundwater pollution, including accidental spills of petroleum products into sinkholes. To avoid or minimize potential impacts, the Forest Plan has several standards to protect karst resources. A minimum of 200 foot buffers is maintained around cave entrances, sinkholes, and cave collapse areas known to open into a cave's drainage system. There are no soil-disturbing activities and trees are not harvested within this buffer. Wider buffers are identified through site-specific analysis when necessary to protect caves from potential subterranean and surface impacts. Management activities within any area draining into a cave are limited if they may affect the cave ecosystem through sedimentation, soil sterilization, the addition of nutrients or other chemicals (including pesticides, herbicides, and fertilizers), or change the cave's natural hydrology. Another standard requires 1) identification of geologic features, such as karst features, using the appropriate type and scale of geologic mapping, and 2) integration of the geology, including karst, into the siting and design of the project. In addition to the standards, the review and environmental analysis of the proposed APD, including proposed drilling plan for each well, would help to avoid or minimize effects on karst resources.

Prior to drilling wells on the Forest, the state and federal government review the proposed drilling plans in light of known caves, known mines and known karst features. This review is conducted in order to avoid sedimentation, pollution, and physical breach into subsurface voids. It is in the operators' interest to avoid subsurface openings. If voids are encountered during drilling, operators are required to cease operations until the void is sealed (cased).

On the Clinch RD limestone bedrock with some karst features (caves, sinkholes) is found in 5th level HUC watersheds 0601020601, 0601020504, and 0601020505. The

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limestone on the Clinch RD occurs mainly in relatively narrow bands near the Forest boundary, such as the Staunton Mc Gee Creek drainage, the North Fork Clinch drainage, and Powell River drainage. Using the acres disturbed by federal oil and gas activity as an indicator of potential effect on karst resources, the potential effect is indicated by the "Subtotal: acres disturbed (b) + (g) + 9j)" for each Alternative displayed by 5th level HUC watersheds on Clinch Ranger District in Table 3-188 "Reasonably foreseeable development on federal oil and gas leases on National Forest by Alternative by 5th level HUC watersheds on Clinch Ranger District." Because the limestone occurs on a small part of the federal acreage, this indicator overstates the acreage that might affect karst. Because of the Forest Plan standards, the protective measures in APD, and the relatively small area of limestone on the Clinch RD, the potential effects of federal oil and gas activity on karst resources are likely to be avoided or minimized. For the same reasons, and because even fewer wells are likely to be proposed on the remainder of the Forest, the potential effects of federal oil and gas activity on karst resources on the rest of the Forest are likely to be avoided or minimized.

In regard to broad, landscape-level geologic features, such as Pine Mountain or the Russell Fork boulder field at the northeast end of Pine Mountain, the Alternatives have the potential to construct roads and well pads into parts of such areas. The roads and well pads can detract from the natural appearance of these geologic features. Some Alternatives have a Geologic Areas management prescription that provides additional stipulations such as Controlled Surface Use stipulation for Special Geologic Areas. The potential effects of federal oil and gas activity would be reduced in areas with the Special Geologic Areas management prescription. These areas are displayed by Alternative in the Geologic Resources section of the Forest Plan DEIS.

Because the Forest's watersheds are mainly mountainous watersheds, landslides are an important natural disturbance that plays a major role in flooding, sedimentation, and the functioning of riparian areas. Landslides include a wide range of mass movements such as, debris avalanches, debris slides, debris flows, slumps, rockslides, stream channel bank failures, etc. Infrequent storms with intense rainfall can trigger numerous landslides that drastically increase the destructive power of floods by creating debris floods. The construction and maintenance of roads, well pads, and other facilities associated with federal oil and gas activity may cause, or contribute to causing, landslides (mass movements) such as cut slope failures and fill slope failures. Some landslide material may reach stream channels and add to the sediment yield. During floods, some landslides caused by these activities may add destructive surges to the flood directly by swelling flood discharge with landslide debris (debris flows), or indirectly by swelling the flood discharge with the failure of landslide-created dams in the flooded channel. These potential landslides and debris floods would be in addition to natural landslides and debris floods that are part of the natural disturbance regime.

Landslides caused by federal oil and gas activities have the potential to increase sediment yield. Road cut or fill slopes along creeks or at creek crossings may fail and deposit all or most of road slope failure as sediment directly into a creek. Roads on side-hill locations away from streams may fail, but only a minor portion of these road slope failures would be washed away to be deposited as sediment in a creek. In contrast, many natural landslides commonly found on this Forest, such as debris slides, deliver the slide material directly into stream channels. Three common locations for natural landslides are: 1) the steep headwater chutes of mountain streams, 2) the steep inner gorges along mountain streams, and 3) the channel banks along valley streams.

Some road slope failures may occur in any year after the roads are built, including years with little rain. However, most road slope failures are likely to occur during years when natural landslides are also occurring in the same area. The infrequent, intense rainstorms that triggers road slope failures also triggers natural landslides. The number and size of road slope failures and natural landslides tend to increase with increasing quantity, intensity and duration of rainfall. As a result, those years when road slope failures are abundant are likely to be those years when the annual sediment yield due to natural landslides is higher than normal. The intense rainstorms that trigger natural landslides produce background sediment yield that range from 1 to 4 orders of magnitude higher than normal background. Normal background might be an annual sediment yield of tens of tons per square mile; the natural landslides from an intense storm could raise the annual sediment yield to hundreds or thousands or tens of thousands or hundreds of thousands of tons per square mile. In such intense rainfall events, the management-caused or -influenced landslides are estimated to be a very small percentage of the total sediment for that event.

Standards under all Alternatives provide for geologic investigations of potential landslide hazards as part of the siting, design, and maintenance of roads and other RFD activities. Those Alternatives that have more earth-moving activity (road construction, well pad, construction) are estimated to have more potential to cause, or contribute to causing, landslides than those Alternatives with less earth-moving activity. The acres of earth-moving activity (roads, well pads and pipelines) by Alternative for 5th level HUC watersheds on the Clinch RD is shown is as “Subtotal: acres disturbed (b) + (g) + 9j)” on Table 3-188 “Reasonably foreseeable development on federal oil and gas leases on National Forest by Alternative by 5th level HUC watersheds on Clinch Ranger District.” Using these acres of earth-moving activity as an indicator of potential for landslide effects, the potential effect is indicated by the “Subtotal: acres disturbed (b) + (g) + 9j)” for each Alternative displayed by 5th level HUC watersheds on Clinch Ranger District in that Table. For the remainder of the Forest, for all Alternatives, the RFD estimates for New River Valley and New Castle Ranger Districts two wells and associated roads with total of 9 acres of earth-moving activity in each of the following 5th level HUC watersheds: 0208020103, 0208020108, 0505000108, 0505000110, 0505000202, 0505000203, 0601010101, and 0601010202.

Federal oil and gas activities, such as drilling and well plugging, would add an increment to past, present and future activities on and off the Forest that have potential effects on groundwater. Past, present, and future oil and gas activities on and off the Forest are discussed in the RFD. State government also requires operators to obtain a permit before drilling an oil and gas well. The State government, like the federal government, reviews proposed drilling plans and requires measures to protect groundwater. The Virginia Division of Oil and Gas, Virginia’s Gas and Oil Act of 1990 and the regulation authorized by that act require an operating permit and place special emphasis on water quality protection, erosion and sediment control, and protection of the public from safety hazards. In regard to oil and gas activities from outstanding and reserved mineral rights on NFS lands on the Clinch RD, the number of wells drilled is used as an indicator of potential to effect groundwater. The potential effect is indicated by the number of wells in each Alternative displayed by 5th level HUC watersheds on Clinch Ranger District as displayed Table 3-189 “Reasonably foreseeable development of private oil and gas wells (outstanding/reserved mineral rights) on National Forest by Alternative by 5th level HUC watersheds on Clinch Ranger District”. Similarly, for wells off the Forest, the potential effect on groundwater is indicated by the number of wells as displayed in Table 3-190 “Reasonably foreseeable development of oil and gas wells off the National Forest by Alternative by 5th level HUC watersheds on Clinch Ranger District”. Some coal mining occurred on the Forest in the past, and may occur in the future. Past, present, and future coal mining activities, primarily off the Forest, are part of the cumulative impacts on groundwater.

Most karst areas are located off the Forest. Past and present activities off the Forest have been affecting karst areas for over 200 years. Extensive changes in land use and extensive ground disturbance have occurred. Within fifth level HUC watersheds, activities off the Forest that might have effects on karst hazards include road construction, timber harvest, oil and gas activity, coal mining, farming, and residential and urban development. In the future, more development can be expected on karst areas off the Forest. The cumulative effects on karst are largely due to activities off the Forest. The potential effects on karst hazards of any Alternative are expected to be a very minor addition to cumulative effects.

Landslides and debris floods are natural disturbances that have brought episodes of sudden and massive changes to streams, riparian areas, and watersheds over thousands of years. These natural disturbances, often catastrophic, will continue in the future. Within each fifth level HUC watershed, the potential effects of the Alternatives on landslides and debris floods would be added to the effects of 1) past, present and future natural landslides and debris floods, 2) past and present activities on the Forest, 3) past, present and future activities off the Forest. The effects of human activities on flooding and landslides on lands now part of the Forest was greatest in the 19th and early 20th century prior to establishment of the Forest in the 1930's. During that period, extensive mountains areas were clearcut logged without the standards of a Forest Plan or the federal regulations that control impacts on floodplains and erosion on the Forest. Railroads were constructed into steep mountain drainages to log hillsides, steep hollows, and floodplains. Forests were cleared and the ground plowed for farming in the mountains. Coal exploration and mining was and is a major activity in southwest Virginia, and part of that activity occurred on the Clinch RD. All these land disturbances taking place in a largely unregulated environment of the 19th and early 20th century had severe impacts on watersheds and flooding. It was severe impacts on watersheds and flooding that led to the creation of National Forests such as the Jefferson NF. Since the creation of the Forest, the previously cut-over forest land has been allowed to grow into extensive forests that reduce the effects of natural floods and landslides. Additional discussion of cumulative impacts is in the Geologic Resources and Geologic Hazards section of the Forest Plan EIS.

Within fifth level HUC watersheds, activities off the Forest that might have effects on landslides or flooding include road construction, timber harvest, mining, farming, and residential and urban development. The off-Forest land disturbances taking place in a largely unregulated environment of the 19th and early 20th century had severe impacts on watersheds, landslides, and flooding. From the 1930's to the present, the most extensive land disturbances have been occurring off the Forest, not on the Forest. Off the Forest, major land uses changes have been occurring, such as construction of two-lane and four-lane highways, rural and urban development, farming and timber harvest. Recent development off the Forest includes increasing new road construction and residential development in mountainous areas. This trend of increasing development on steep slopes off the Forest is likely to continue into the future. The development of roads and cut-and-fill construction for residences in mountainous areas do not usually have geologic reports to inventory geologic hazards such as landslides and to consider geologic hazards in siting and design of the development. Future development off the Forest has the potential to cause, or contribute to causing, landslides, and thus, to increase cumulative effects.

AQUATIC SPECIES

The Reasonably Foreseeable Development (RFD) for federal oil and gas on the Jefferson National Forest is concentrated on the Clinch Ranger District. On the Clinch District, this includes parts of the following five fifth code HUC watersheds: 0507020203, 0507020205, 0601020504, 0601020505, and 0601020601. Other watersheds with National Forest system land that have a minor possibility of reasonably foreseeable development are 0208020103, 0208020108, 0505000108, 0505000110, 0505000202, 0505000203, 0601010101, and 0601010202. Federally endangered, threatened, and Forest Service sensitive aquatic species in any of those watersheds are found in Table 3-196.

The majority of the species listed in Table 3-196 are not found on the Jefferson National Forest, but downstream, in the watershed. The Jefferson National Forest proposed aquatic Management Indicator Species (MIS), wild trout, also occurs in these watersheds on both National Forest and private land.

As discussed in the Hydrology section, the physical effects of oil and gas leasing include erosion and sedimentation. Soil disturbing activities include construction or reconstruction of access roads, clearing and leveling of drill pad sites, and construction of pipelines. In addition, the construction of road crossings can restrict the migration and movement of aquatic species by hanging culverts, high water velocity, inadequate swimming depth, or any combination of these factors.

These soil-disturbing activities can directly affect sediment transport in streams if they increase (or decrease) the supply of sediment, if they alter the peak flow or the frequency of high flows, and if they change the structure of the channel by removing the supply of large woody debris that forms sediment storage sites. Bank erosion and lateral channel migration also contribute sediments if protective vegetation and living root systems are removed. Sedimentation can occur from natural events such as landslides and large rain events, as well as from human-made disturbances such as road building, road failures, recreation trails, logging and the clearing of land down to mineral soil. Through application of mitigation measures and Best Management Practices, these impacts can be largely avoided.

The physical removal of vegetation at sites away from the streams poses very little direct threat to the aquatic resource or organisms. The use and construction of temporary and permanent roads and drill pad sites could increase the amount of sediment entering the stream system during periods of high flow. Sediment loading in streams affects the aquatic fauna directly and indirectly. Direct effects include damage to gills by abrasion of suspended particles. Indirect effects come from a reduction in available dissolved oxygen, and reduced surface area and spawning habitat due to substrate being covered with sediment. When sediment enters the stream channel it can have a dramatic effect on fish breeding success, if spawning habitat is covered with a layer of fine sediment. Embedded spawning gravels can cause fish to avoid using the gravels, or if they do lay eggs, can cause those eggs to become coated with a sediment layer. Without a sufficient flow of water and available oxygen flowing through the spawning gravels the eggs will die. When sediment enters a stream system it can persist for years, decades, or centuries depending on the amount of sediment delivered to the stream system. Application of relevant Forest Plan standards and mitigation measures will minimize the amount of sediment actually reaching the streams.

Aquatic habitats are included in the Riparian Habitat management prescription (11), which does not vary by alternative. Under this management prescription, riparian areas and aquatic resources are managed to encourage the processes that maintain or lead to a desired future condition for fisheries and aquatic habitats. The Forest Plan designates riparian corridors for perennial and intermittent streams, and common standards for channeled ephemeral streams. The riparian corridor will be managed to retain, restore, and/or enhance the inherent ecological processes and functions of the associated aquatic, riparian, and upland components within the corridor in all alternatives. These

Table 3-196. Federally Endangered (E), Threatened (T), Forest Service Sensitive (S), Extinct or Extirpated (EX), and Locally Rare (LR) Aquatic Species within the 5th Level HUC Watersheds where Federal Oil and Gas Development May Occur

Common Name	Scientific Name	Status	Watershed
spring blue darner	*Aeshna mutata*	LR	0208020103
black-tipped darner	*Aeshna tuberculifera*	LR	0208020103
dot-tailed whiteface	*Leucorrhinia intacta*	LR	0208020103
James River spinymussel	*Pleurobema collina*	E	0208020103
Appalachian jewelwing	*Calopteryx angustipennis*	LR	0208020108
Yellow lance	*Elliptio lanceolata*	S	0208020108
Atlantic pigtoe	*Fusconaia masoni*	S	0208020108
Green-faced clubtail	*Gomphus viridifrons*	S	0208020108
Roughhead shiner	*Notropis semperasper*	S	0208020108
Orangefin madtom	*Noturus gilberti*	S	0208020108
James River spinymussel	*Pleurobema collina*	E	0208020108
black-tipped darner	*Aeshna tuberculifera*	LR	0505000110
comet darner	*Anax longipes*	LR	0505000110
Green-faced clubtail	*Gomphus viridifrons*	S	0505000110
double-striped clubtail	*Lanthus parvulus*	LR	0505000110
Green floater	*Lasmigona subviridis*	S	0505000110
northern common spreadwing	*Lestes disjunctus disjunctus*	LR	0505000110
dot-tailed whiteface	*Leucorrhinia intacta*	LR	0505000110
Allegheny snaketail	*Ophiogomphus alleghaniensis*	S	0505000110
Candy darter	*Etheostoma osburni*	S	0505000202
Green floater	*Lasmigona subviridis*	S	0505000202
Kosztarab's common stonefly	*Acroneuria kosztarabi*	S	0505000203
black-tipped darner	*Aeshna tuberculifera*	LR	0505000203
Candy darter	*Etheostoma osburni*	S	0505000203
Beartown perlodid stonefly	*Isoperla major*	S	0505000203
Tennessee Heelsplitter	*Lasmigona holstonia*	S	0505000203
Green floater	*Lasmigona subviridis*	S	0505000203
William's giant stonefly	*Megaleuctra williamsae*	S	0505000203
Green-faced clubtail	*Gomphus viridifrons*	S	0507020205
black-tipped darner	*Aeshna tuberculifera*	LR	0601010101
elktoe	*Alasmidonta marginata*	LR	0601010101
Spotfin chub	*Cyprinella monacha*	T	0601010101
Slender chub	*Erimystax cahni*	T	0601010101
Shiny pigtoe	*Fusconaia cor*	E	0601010101
Green-faced clubtail	*Gomphus viridifrons*	S	0601010101
Mountain brook lamprey	*Ichthyomyzon greeleyi*	S	0601010101
Spiny riversnail	*Io fluvialis*	S	0601010101
Slabside pearlymussel	*Lexingtonia dolabelloides*	S	0601010101
Popeye shiner	*Notropis ariommus*	S	0601010101
Little-wing pearlymussel	*Pegias fabula*	E	0601010101
Blotchside logperch	*Percina burtoni*	S	0601010101
Longhead darter	*Percina macrocephala*	S	0601010101
Tennessee dace	*Phoxinus tennesseensis*	S	0601010101
Purple lilliput	*Toxolasma lividus*	S	0601010101

Table 3-196 Cont'd. Federally Endangered (E), Threatened (T), Forest Service Sensitive (S), Extinct or Extirpated (EX), and Locally Rare (LR) Aquatic Species within the 5th Level HUC Watersheds where Federal Oil and Gas Development May Occur

Common Name	Scientific Name	Status	Watershed
elktoe	*Alasmidonta marginata*	LR	0601010202
Black sculpin	*Cottus baileyi*	S	0601010202
Spotfin chub	*Cyprinella monacha*	T	0601010202
Tan riffleshell	*Epioblasma florentina walkeri*	E	0601010202
Tennessee pigtoe	*Fusconaia barnesiana*	S	0601010202
Shiny pigtoe	*Fusconaia cor*	E	0601010202
Cracking pearlymussel	*Hemistena lata*	E	0601010202
Tennessee Heelsplitter	*Lasmigona holstonia*	S	0601010202
Slabside pearlymussel	*Lexingtonia dolabelloides*	S	0601010202
Black sandshell	*Ligumia recta*	LR	0601010202
Mirror shiner	*Notropis spectruculus*	LR	0601010202
Little-wing pearlymussel	*Pegias fabula*	E	0601010202
Longhead darter	*Percina macrocephala*	S	0601010202
Tennessee dace	*Phoxinus tennesseensis*	S	0601010202
Tennessee clubshell	*Pleurobema oviforme*	S	0601010202
Slippershell mussel	*Alasmidonta viridis*	LR	0601020504
Fanshell	*Cyprogenia stegaria*	E	0601020504
Elephant ear	*Elliptio crassidens*	LR	0601020504
Cumberlandian combshell	*Epioblasma brevidens*	E	0601020504
Oyster mussel	*Epioblasma capsaeformis*	E	0601020504
Green-blossom pearlymussel	*Epioblasma torulosa gubernaculum*	EX	0601020504
Snuffbox	*Epioblasma triquetra*	S	0601020504
Tippecanoe darter	*Etheostoma tippecanoe*	S	0601020504
Tennessee pigtoe	*Fusconaia barnesiana*	S	0601020504
Shiny pigtoe	*Fusconaia cor*	E	0601020504
Fine-rayed pigtoe	*Fusconaia cuneolus*	E	0601020504
Cracking pearlymussel	*Hemistena lata*	E	0601020504
Spiny riversnail	*Io fluvialis*	S	0601020504
Pink mucket pearlymussel	*Lampsilis abrupta*	EX	0601020504
Birdwing pearlymussel	*Lemiox rimosus*	E	0601020504
Fragile papershell	*Leptodea fragilis*	LR	0601020504
Slabside pearlymussel	*Lexingtonia dolabelloides*	S	0601020504
Black sandshell	*Ligumia recta*	LR	0601020504
Popeye shiner	*Notropis ariommus*	S	0601020504
Emerald shiner	*Notropis atherinoides*	LR	0601020504
Mirror shiner	*Notropis spectruculus*	LR	0601020504
Sheepnose	*Plethobasus cyphyus*	S	0601020504
Tennessee clubshell	*Pleurobema oviforme*	S	0601020504
Rough rabbitsfoot	*Quadrula cylindrica strigillata*	E	0601020504
Pimpleback	*Quadrula pustulosa*	LR	0601020504
Appalachian monkeyface pearly-mussel	*Quadrula sparsa*	E	0601020504
Deertoe	*Truncilla truncata*	LR	0601020504
elktoe	*Alasmidonta marginata*	LR	0601020505
Western sand darter	*Ammocrypta clara*	S	0601020505
Spectaclecase	*Cumberlandia monodonta*	S	0601020505

Table 3-196 Cont'd. Federally Endangered (E), Threatened (T), Forest Service Sensitive (S), Extinct or Extirpated (EX), and Locally Rare (LR) Aquatic Species within the 5th Level HUC Watersheds where Federal Oil and Gas Development May Occur

Common Name	Scientific Name	Status	Watershed
Steelcolor shiner	*Cyprinella whipplei*	LR	0601020505
Fanshell	*Cyprogenia stegaria*	E	0601020505
Dromedary pearlymussel	*Dromus dromas*	E	0601020505
Elephant ear	*Elliptio crassidens*	LR	0601020505
Cumberlandian combshell	*Epioblasma brevidens*	E	0601020505
Oyster mussel	*Epioblasma capsaeformis*	E	0601020505
Green-blossom pearlymussel	*Epioblasma torulosa gubernaculum*	EX	0601020505
Snuffbox	*Epioblasma triquetra*	S	0601020505
Slender chub	*Erimystax cahni*	T	0601020505
Duskytail darter	*Etheostoma percnurum*	E	0601020505
Tippecanoe darter	*Etheostoma tippecanoe*	S	0601020505
Tennessee pigtoe	*Fusconaia barnesiana*	S	0601020505
Shiny pigtoe	*Fusconaia cor*	E	0601020505
Fine-rayed pigtoe	*Fusconaia cuneolus*	E	0601020505
Cracking pearlymussel	*Hemistena lata*	E	0601020505
Mountain brook lamprey	*Ichthyomyzon greeleyi*	S	0601020505
Spiny riversnail	*Io fluvialis*	S	0601020505
Tennessee Heelsplitter	*Lasmigona holstonia*	S	0601020505
Birdwing pearlymussel	*Lemiox rimosus*	E	0601020505
Fragile papershell	*Leptodea fragilis*	LR	0601020505
Slabside pearlymussel	*Lexingtonia dolabelloides*	S	0601020505
Black sandshell	*Ligumia recta*	LR	0601020505
Emerald shiner	*Notropis atherinoides*	LR	0601020505
Mirror shiner	*Notropis spectruculus*	LR	0601020505
Blotchside logperch	*Percina burtoni*	S	0601020505
Sheepnose	*Plethobasus cyphyus*	S	0601020505
Ohio river pigtoe	*Pleurobema cordatum*	S	0601020505
Rough pigtoe	*Pleurobema plenum*	S	0601020505
Pyramid pigtoe	*Pleurobema rubrum*	S	0601020505
Rough rabbitsfoot	*Quadrula cylindrica strigillata*	E	0601020505
Cumberland monkeyface pearlymussel	*Quadrula intermedia*	E	0601020505
Pimpleback	*Quadrula pustulosa*	LR	0601020505
Appalachian monkeyface pearlymussel	*Quadrula sparsa*	E	0601020505
Deertoe	*Truncilla truncata*	LR	0601020505
Purple bean	*Villosa perpurpurea*	E	0601020505
Cumberland bean	*Villosa trabalis*	EX	0601020505
elktoe	*Alasmidonta marginata*	LR	0601020601
comet darner	*Anax longipes*	LR	0601020601
A crayfish	*Cambarus veteranus*	LR	0601020601
Spiny riversnail	*Io fluvialis*	S	0601020601
Tennessee Heelsplitter	*Lasmigona holstonia*	S	0601020601
Fragile papershell	*Leptodea fragilis*	LR	0601020601
Popeye shiner	*Notropis ariommus*	S	0601020601
Blackside dace	*Phoxinus cumberlandensis*	T	0601020601
Rough rabbitsfoot	*Quadrula cylindrica strigillata*	E	0601020601

standards and guidelines may have a beneficial effect on the communities and their associated species.

If this project is implemented with full consideration of the Riparian management prescription and channeled ephemeral stream standards, no direct or indirect adverse effects to aquatic organisms or to the aquatic habitat that sustain them will occur. There will be no direct or indirect adverse effect to wild trout.

Direct and indirect adverse effects to aquatic communities are minimized by the riparian and forest-wide watershed standards; however, they are not eliminated from the entire watershed. Incrementally, the adverse effects of Forest Service activities could accumulate to levels that threaten the viability of aquatic species. In addition to Forest Service lands, activities are also carried out on private lands in many of the 5th level watersheds. Since the viability of an aquatic species is generally assessed at the 5th level or higher watershed, it is important to consider all activities that might affect its viability regardless of land ownership.

A cumulative effects analysis should consider incremental impacts of actions when added to past, present, and reasonably foreseeable future actions. The analysis should include all actions regardless of who undertakes them. Cumulative impacts can result from individually minor but collectively significant actions taking place over time. For this document, cumulative effects were analyzed through a two-part watershed analysis, which included resource assessment and management prescription (Reid 1998). See the Fisheries and Aquatic Habitat section of the EIS for further discussion on this process.

Included in the resource assessment, individual watershed factors as well as combination of factors were considered and evaluated to determine the present condition of each watershed based on cumulative past and ongoing activities within it. These were used to validate the Watershed Condition Rank (WCR), as described in the Water Resources Section (Table 3-10).

Since the most likely effects from oil and gas leasing activities are from erosion and sedimentation, this cumulative effects analysis focuses on the WCR for each watershed. WCR characterizes cumulative effects of sediment from private and National Forest land within a specified watershed. It takes into account biological thresholds for sediment. Possible Watershed Condition Ranks are: Excellent (E); Average (A); or Below Average (BA). The below average (BA) WCR indicates that a biological threshold for effects from sediment is being reached (See Table 3-10 in the Water Resources Section). The WCR for this analysis was developed from data specific to Virginia. As part of the watershed assessment, the WCR values were verified and adjusted according to local knowledge and data (described above and in the Water Resources section).

The watersheds specific to the proposed oil and gas leasing are found in table 3-196. Table 3-10 in the Hydrology section displays the WCR for each watershed and each alternative for period one, as well as the current WCR. As the table shows, there would be no change in the WCR from current for any of the alternatives for those watersheds specific to the proposed oil and gas leasing.

Concurrently with the resource assessment, the Forest carried out an interdisciplinary analysis looking at interactions between resources with a goal of managing riparian corridors to retain, restore, and /or enhance the inherent ecological processes and functions of the associated aquatic, riparian, and upland components within the corridor, while minimizing effects to aquatic and riparian resources from other activities. This was done through many meetings and discussions, which included not only multi-agency resource professionals, but members of the public as well. From this work, prescriptions, goals, objectives, and standards were developed in order to focus management on riparian, aquatic, and healthy watershed needs. This is documented in the proposed Forest Plan, Chapter 4, the identification of Priority Watersheds (Revised Forest Plan Table 2-1), and the development of Management Prescriptions 9A1 (Source Water Protection), 9A2 (Reference Watersheds), 9A3 (Watershed Restoration Areas), 9A4 (Aquatic Habitat Areas) and 11 (Riparian Corridors). These prescriptions were designed to not only minimize adverse impacts to aquatic and riparian areas, but to maintain them as healthy, functioning systems.

Resulting from the careful development of prescriptions and standards, there should be beneficial effects on in-stream uses (including federally listed aquatic species) during the implementation of the proposed Forest Plan. These beneficial effects include, but are not limited to: watershed restoration activities, road and recreation site maintenance, reconstruction, relocation, and/or closure/rehabilitation; and control and management of livestock. Buffer zone filter strips will limit sediment produced by ground disturbing from entering a stream system. Management of Federal leasable minerals according to standard lease terms, additional stipulations, surface use plan of operations, as well as Federal and State laws governing both private and Federal mineral development will limit sediment and other pollutants from entering a stream system. Management of streamside areas for riparian purposes and needs will increase large woody debris and shade. Stream crossings of roads will allow the passage of desired aquatic organisms.

Forest objectives for watersheds with an Excellent or Average WCR are to maintain or improve aquatic health through the implementation of riparian management prescription standards. The probability is low to moderate, respectively, for adverse effects to aquatic species and their associated habitats in these watersheds. Forest objectives for watersheds with Below Average WCR are the same as watersheds with Average or Excellent WCR ratings with the additional requirement that during watershed assessments, surveys are conducted to determine the sources of impairment and prescribe appropriate treatments when they occur on National Forest system lands. Any effects from management activities will be insignificant or discountable and therefore, there will be no adverse cumulative watershed effects from oil and gas development to aquatic species.

VEGETATION

The Reasonably Foreseeable Development (RFD) for federal oil and gas on the Jefferson National Forest is primarily on the Clinch Ranger District. The Clinch Ranger District has a full range of Major Forest Community Types with a high percentage of very productive sites depending upon the specific location of projected activities. As Table 3-197 indicates, the level of clearing for RFD during the first 10 years of plan implementation is minimal when

Table 3-197. Acres Cleared and Associated Timber Removal Volumes for the RFD

Alternative	Acres Cleared	Volume (CCF, hundred cubic feet)
A	396	7,920
B	430	8,600
D	399	7,980
E	416	8,320
F	513	10,260
G	427	8,540
I	417	8,340

Assumption of average volume per acre cleared equals 20 CCFs.

expressed in the context of an approximately 92,000 acre Ranger District.

As Table 3-197 displays, there is very little difference in the projected area to be cleared among alternatives during the first 10 years of plan implementation.

All vegetation would be removed from the acres cleared for well sites, access roads, and associated pipelines. Some revegetation or restoration of disturbed areas after completion of gas exploration may eventually result in similar vegetation being established on portions of the cleared area.

Fair market value for timber volume indicated in Table 3-197 will be obtained through timber settlement sale or commercial timber sale regulations as individual site development occurs. Every effort will be made to make marketable timber available to local markets.

All environmental and social effects for the above levels of clearing are identified under the appropriate social or resource program headings.

RARE COMMUNITIES AND BOTANICAL – ZOOLOGICAL AREAS

The majority of the Reasonably Foreseeable Development for oil and gas will occur on the Clinch Ranger District. A very small amount of exploratory activity may occur on the New Castle and New River Valley Districts. A number of rare communities and botanical – zoological areas occur on the Forest and they act as a “coarse filter” for the protection of biological diversity. According to SAMAB (1996:41) about 66% of TES species are associated with rare communities, and the percentage increases even further when riparian areas are included. By protecting rare communities, a very large number of TES plant and animal species also receive protection. Added to this are botanical and zoological areas where single occurrences or assemblages of TES species are recognized and protected.

Applicable Standards for Rare Communities from the Forest Plan:

9F-024 Rare communities are available for federal oil and gas leasing with a no surface occupancy stipulations to protect threatened, endangered, sensitive, and locally rare species. Other Federal minerals may be available on a case-by-case basis after full consideration of effects on the rare community.

9F-025 These areas are not available for mineral materials for commercial purposes. Administrative use of mineral materials is allowed when: a) the materials are used within the rare community itself; and b) use is necessary to protect the rare community and threatened, endangered, sensitive, and locally rare species habitats.

9F-026 Federal oil and gas leases and reserved and outstanding minerals rights exist in some of these areas. Roads, wells, and other necessary infrastructure associated with these rights are allowed. Requests for access to a non-Federal interest in lands pursuant to a reserved or outstanding right are recognized, and reasonable access is granted. Encourage such interests to minimize disturbance to threatened, endangered, sensitive, and locally rare species habitats.

9F-028 New roads needed for mineral access are engineered to minimize impacts to the rare community and managed as closed to public motorized use.

> **FW-41** Known occurrences of Virginia spirea, small-whorled pogonia, northeastern bulrush, and Virginia round-leaf birch are allocated to Management Prescriptions 4D and 9F to ensure protection and maintenance of their current populations and surrounding habitat conditions.

Applicable Standards for Botanical-Zoological Areas from the Forest Plan:

> **4D-014** These areas are available for federal oil and gas leasing with additional stipulations like controlled surface use to protect threatened, endangered, sensitive, and locally rare species. Other Federal minerals may be available on a case-by-case basis after full consideration of effects on threatened, endangered, sensitive, and locally rare species.

> **4D-015** Permit mineral materials for commercial, personal, free, and administrative use purposes with conditions to protect threatened, endangered, sensitive, and locally rare species habitat.

> **4D-016** Federal oil and gas leases exist in some of these areas. Roads, wells, and other necessary infrastructure associated with these leases are allowed. Existing lease stipulations are used to minimize disturbance to threatened, endangered, sensitive, and locally rare species habitat.

> **4D-017** Private mineral rights exist in some of these areas. Roads, wells, and other necessary infrastructure associated with these rights are allowed. Requests for access to a non-Federal interest in lands pursuant to a reserved or outstanding right are recognized, and reasonable access is granted. Encourage such interests to minimize disturbance to threatened, endangered, sensitive, and locally rare species habitat.

> **FW-41** Known occurrences of Virginia spiraea, small-whorled pogonia, northeastern bulrush, and Virginia round-leaf birch are allocated to Management Prescriptions 4D and 9F to ensure protection and maintenance of their current populations and surrounding habitat conditions.

The possible effects of oil and gas development on Rare Communities and Botanical-Zoological Areas include removal of tree species, ground disturbance, changes in hydrology, changes in soil temperature, and possible invasion by non-native species. Even though there may be activities associated with oil and gas development, the Plan Standards provide protection for threatened, endangered, and sensitive species that occur within Rare Communities and Botanical-Zoological Areas. The areas may receive some disturbance, but project and site-specific analysis will include mitigation to prevent damage to the integrity of these areas and the species that depend on them.

MANAGEMENT INDICATOR SPECIES

Concerns regarding overall biodiversity of the areas proposed for federal oil and gas development are best addressed through the use of Management Indicator Species (MIS) as designated by the Forest Plan (Table 3-198).

Wildlife resources on the Forest are primarily located in the Commonwealth of Virginia, thus wildlife and fish species are managed in cooperation with the Virginia Department of Game and Inland Fisheries (VDGIF). Small acreages are located in West Virginia and Kentucky. State wildlife agencies set policy for hunting and fishing regulations and associated law enforcement programs. The Forest Service manages the habitat conditions for wildlife. The following discussion focuses on the habitat conditions that support wildlife

Table 3-198. Management Indicator Species for the Jefferson National Forest

Common Name	Scientific Name
Peaks of Otter salamander	*Plethodon hubrichti*
Pileated woodpecker	*Dryocopus pileatus*
Ovenbird	*Seiurus aurocapillus*
Chestnut-sided warbler	*Dendroica pensylvanica*
Acadian flycatcher	*Empidonax virescens*
Eastern towhee	*Pipilo erythrophthalmus*
Black bear	*Ursus americanus*
Wild turkey	*Melagris gallopavo*
White-tailed deer	*Odocoileus virginianus*
Hooded warbler	*Wilsonia citrina*
Scarlet tananger	*Piranga olivacea*
Pine warbler	*Dendroica pinus*
Wild trout (brook trout, rainbow trout, brown trout)	*Salvelinus fontinalis, Oncorhynchus mykiss, Salmo trutta*

populations in the project areas.

Under the National Forest Management Act (NFMA) the Forest Service is charged with providing for a diversity of plant and animal communities consistent with overall multiple-use objectives. Management Indicator Species (MIS) are a planning tool used to accomplish this requirement (36 CFR 219.19). They are selected during forest planning "because their population changes are believed to indicate the effects of management activities" (36 CFR 219.19(a)(1)) on important elements of plant and animal diversity. See Table 3-198.

The Reasonably Foreseeable Development (RFD) for federal oil and gas on the Jefferson National Forest is concentrated on the Clinch Ranger District. The remainder of the forest is included in the RFD area but contains no current leases and has low potential for mineral development. The Clinch Ranger District contains a variety of habitat types and associated wildlife species.

Habitat Requirements of MIS

Peaks of Otter Salamander. This salamander is a species with a very restricted range. It's endemic to an area of the Blue Ridge Mountains north of the Peaks of Otter near Apple Orchard Mountain in Bedford and Botetourt County. This terrestrial salamander is endemic to a small area (approximately 26,000 acres) where it inhabits the forest leaf litter and surfaces beneath rocks and downed wood under a mature hardwood forest canopy. It forages openly on cool to warm, dark, humid nights consuming small insects and other invertebrates (Wilson, 1995). The Peaks of Otter salamander is an MIS because it is a Sensitive species and a narrow endemic that occurs almost entirely on the Jefferson National Forest (Glenwood Ranger District) and adjacent Blue Ridge Parkway lands. While a significant portion of the range is dedicated to non-management uses, timber harvest is allowed in about 60% of the range. Population comparisons between managed and non-managed areas can indicate the effects of timber management on this species. The Peaks of Otter salamander does not occur within the proposed project area. Federal oil and gas development is not proposed for the Glenwood Ranger District. Since the Peaks of Otter salamander only occurs on the Glenwood RD it is not included in any discussion that follows. The remaining species will be included in the effects analysis because either the species or habitat that could support these species exists in the project area.

Pileated Woodpecker. The Pileated Woodpecker generally prefers mature deciduous forests ranging from bottomlands to uplands. Key habitat requirements include older mature forests with dead trees (snags) for nesting. Pileated woodpeckers will also nest in large dead limbs on live trees. Nests are large cavities they construct usually over 30 feet above the ground. They feed on ants, insects, and insect larvae (mainly carpenter ants and wood-boring beetles) found by probing under the bark of standing trees and in stumps or fallen logs. Some fruits and berries are taken in fall and winter (Hamel, 1992). These woodpeckers are year-round residents. The pileated woodpecker is an MIS for snag dependent wildlife.

Ovenbird. Preferring mature, dry, deciduous hardwoods with a closed canopy, the ovenbird is an area sensitive MIS requiring relatively large undisturbed tracts. As ground nesters, they are especially vulnerable to predators. Breeding habitat is deciduous or mixed forest (rarely pure pine woods) with moderate understory, preferably in uplands. Minimum tract size is 37 acres, (Hamel 1992). Since the ovenbird is a neotropical migrant, arriving in spring and departing the Forest in the fall, declines in populations may be caused by events happening on the wintering areas, not the Forest.

Chestnut-sided Warbler. The habitat of this common warbler is typically second-growth hardwoods and overgrown fields in the Appalachian Mountains over 3,500 feet. On the Forest it’s therefore found in the Blue Ridge, Ridge and Valley, and Cumberland mountains. It’s most numerous in abandoned fields with scattered saplings, along woodland edges, and in open park-like deciduous woods. It nests 1 to 4 feet above the ground in saplings and shrubs and feeds on insects gleaned from leaves and twigs in deciduous vegetation (Hamel, 1992). The chestnut-sided warbler is an MIS for high-elevation early-successional habitats because of its strong association with these habitats, and because its populations should be responsive to forest management efforts that create and sustain such habitats. Also, the chestnut-sided warbler is effectively monitored using established breeding bird survey protocols. Since the chestnut-sided warbler is a neotropical migrant, arriving in spring and departing the Forest in the fall, declines in populations may be caused by events happening on the wintering areas, not the Forest.

Acadian Flycatcher. This common flycatcher is found mainly in moist deciduous forests with a moderate understory near streams. Nests are found on horizontal or down-hanging branches of deciduous trees, usually over a stream. This arboreal hawking insectivore generally sits on a branch 10 to 40 feet high near a stream where it will sally after flying insects (Hamel, 1992). The Acadian flycatcher is deemed an appropriate species to indicate management-induced changes to mature riparian forests. It is highly associated with mature deciduous forests along streams and bottomland hardwoods throughout the Forest. This species is selected to help indicate the effects of management activities on mature riparian habitats. Since the Acadian flycatcher is a neotropical migrant, arriving in spring and departing the Forest in the fall, declines in populations may be caused by events happening on the wintering areas, not the Forest.

Eastern Towhee. Also called the Rufous-sided towhee, this widespread bird is found most commonly in upland brushy habitats, woodland margins, thickets, cut-over woods, and overgrown fields. Key habitat requirements are shrubs, saplings, and understory trees where a thicket is present. Nests are most often located in thickets and brushy places on the ground or in shrubs and saplings up to 5 feet off the ground. They forage on the ground and in low shrubs where they scratch in leaf litter to expose insects, seeds, and fruits that they glean (Hamel, 1992). Towhees are year-round residents although individuals will migrate short distances. The Eastern towhee was selected as an MIS to indicate the effects of management activities on early seral habitats.

Black Bear. Black Bear is an opportunistic species that can thrive in a wide variety of habitats. The black bear's most important habitat need is considered to be freedom from constant human disturbance. The single most important management activity that can affect black bears is access management. Access management does not refer to the prohibition of building or upgrading existing roads, but rather to their subsequent management after construction such as whether they're open or closed and the timing of closure. Roads in and of themselves are not detrimental; it's the use of these roads by the public that affects black bear. The proper management of open road densities is critical to black bear populations. The Forest objective is to limit open interior road densities to no more than one mile of open road per 1,000 acres. Black bears require remote habitat with a component of old trees. At least five percent of the area should be in an age class of older trees and these should be well dispersed over the area. Mature forests with large diameter trees are to provide needed hard mast and hollow den trees.

Eastern Wild Turkey. Wild Turkeys prefer mature forests (mid to late successional) with open understories, temporary and permanent clearings well dispersed, and freedom from disturbance during nesting and brood rearing seasons. The key components of wild turkey habitat in oak-hickory forests are brood habitat, nesting and fall/winter habitat, and freedom from disturbance.

Brood Habitat is the most limiting factor to eastern turkey population in the central Appalachians (Pack, personnel communication). Hens with broods use a wide variety of habitats. These include pastures with hay fields, utility rights-of-way, wildlife clearings, burned areas, and natural glades or savannas; however, the structure of vegetation is as important as vegetation types (Healy 1981). In mature forests, ideal brood habitat includes at least 5% of the area in well-dispersed, permanent grass/herbaceous openings. Ground cover should consist of patchy vegetation that does not impede poult movements, yet provides good horizontal cover from predators, and produces abundant insects for food. Partially canopied (<60%) savannahs that are open and park-like with moderate herbaceous/shrubby understory with little midstory vegetation provide optimal brood habitat.

Nesting and fall/winter habitat may vary from uncut hay fields to areas harvested for timber and burned forests. Nesting habitat should be near brood habitat. Preferred and most successful nest sites seem to be on the edge of extensive stands of brush and herbaceous vegetation. Hard mast (usually acorns) is the most important fall food of the eastern turkey in the central Appalachians. Because of the variation in mast production between oak groups, a variety of oak species best provides sustained mast production. Ideal habitat includes at least 60% of the area in mast bearing age (50 years+).

Freedom from human disturbance to hens and broods during the nesting and brood rearing season should be minimized. No more than one mile of open road per 1,000 acres will minimize this disturbance.

White-Tailed Deer. White-tailed deer use a variety of habitat types. White-tailed deer prefer early successional forest areas, woodland edge, and a mosaic of various forest age classes. A mixture of habitat types and resulting edge insures an abundant food source is available throughout the year. White-tailed deer heavily use hard mast in the fall (usually acorns) and accumulate sustaining fat reserves for the winter. During the winter woody browse makes up the majority of a deer's diet in the central Appalachians. In the spring and summer they consume young growing herbaceous plants, fruits, and woody shoots and leaves. Early successional habitat, generally no larger than 25 acres in size, well dispersed with approximately 10% of the area in the 0-10 age class provides forage and escape cover throughout the year. Well-dispersed forest openings 1/2 to 1 acre in size occupying up to 5% of the area and shrub-grass habitats provide necessary spring/

summer foods. In extensive forested areas a minimum of 60% of the area maintained in mast bearing age (40 years +) provides suitable fall hard and soft mast for white-tailed deer.

Hooded Warbler. Habitat of this common warbler is moist deciduous and mixed forests with a dense understory, as is typically found in rich woods, ravines, and bottomlands. Key habitat requirements are forests (usually deciduous) with a thick, rich understory layer. The hooded warbler is rarely associated with these moist deciduous forests above 4,000 feet (Hamel, 1992). Nests are built 2 to 5 feet above the ground in shrubs and saplings where they are poorly concealed. These warblers forage primarily in shrubs within 15 feet of the ground by gleaning and hawking insect prey. The hooded warbler is an MIS for mid- to late-successional oak and oak-pine forests. Since the hooded warbler is a neotropical migrant, arriving in spring and departing the Forest in the fall, declines in populations may be caused by events happening on the wintering areas south of the U.S. and not on the Forest.

Scarlet Tanager. This common woodland bird is typically found in upland mature deciduous (usually oak) forests for which it was selected as an MIS. It's most common in lower and middle elevations in the mountains up to 4,000 feet and is rarely found over 5,000 feet. The key habitat feature is mature deciduous forests. Nests are located 20 to 50 feet above the ground in a hardwood tree. The scarlet tanager feeds on insects that it gleans from twigs and leaves (Hamel, 1992). In the fall it often will feed on berries. Since the scarlet tanager is a neotropical migrant, arriving in spring and departing in the fall, declines in populations may be caused by events happening on the wintering areas south of the U.S. and not on the Forest.

Pine Warbler. The pine warbler is closely associated with middle-aged to mature pine and pine-oak forests, generally occurring only where some pine component is present. While not among the common warblers, it is considered the most appropriate MIS for the yellow pine habitat component. Nests are built in pines and foraging for insects occurs in the crowns of pines where they glean insects from needles and twigs (Hamel, 1992). Since the pine warbler is a neotropical migrant, arriving in spring and departing the Forest in the fall, declines in populations may be caused by events happening on the wintering areas south of the U.S. and not on the Forest.

Wild Trout (Brook Trout, Rainbow Trout, Brown Trout). These trout are cold-water species that require water temperature less than 69 degrees Fahrenheit, dissolved oxygen values greater than 7.0 parts per million, and sedimentation rates that are in equilibrium with the watershed. To be considered "wild" they must be a reproducing population that is not dependent on stocking. Positive activities within watersheds that support wild trout are those that stabilize or improve the physical and biological conditions of the stream. For a complete discussion of effects on wild trout as an MIS in relation to this project see section titled "Aquatic Species".

Direct, Indirect, and Cumulative Effects

The physical effects of oil and gas leasing upon wildlife include elimination of individual animals and their associated habitat by construction or reconstruction of access roads, clearing and leveling of drill pad sites, and construction of pipelines.

There is no anticipated gas well development in the next two decades on the Glenwood Ranger District and the Mount Rogers National Recreation Area. The potential impacts from new gas well development on the New Castle and New River Valley Ranger Districts would be from a total of approximately 16 new wells and an associated 72 acres of disturbance over the next 15 years. This level of activity is the same for all alternatives.

Existing federal leasing is on the Clinch Ranger District and includes 14 oil and gas leases on approximately 15,000 acres, mostly in the Pine Mountain area, and a request for federal leases on 5,191 acres west of Keokee Lake in Lee County. There are no other current or pending federal leases on the Forest other than on the Clinch Ranger District.

Table 3-199. Approximate acres disturbed (pipelines, roads, well pads) by federal and private well activity on National Forest land over 15-year period

Alternative	Decade 1	Decade 2	Total
A	865	375	1,241
B	931	410	1,340
D	905	399	1,305
E	895	355	1,250
F	1,083	447	1,530
G	900	362	1,262
I	910	343	1,253

Impacts on the Clinch Ranger District from expected disturbance of new gas well sites, associated roads, and pipeline right-of-way clearing from both potential federal leases and potential private gas wells on National Forest land is shown in Table 3-199.

It is apparent from the total acreage disturbed that all Alternatives are very similar in their impacts with Alternative F having the greatest amount of disturbed acreage and Alternative A the least, yet they only differ by 289 acres.

Fragmentation can affect wildlife by encouraging species that use early successional and forest edge habitats, such as the MIS eastern towhee and wild turkey, and discouraging animals that use interior forest habitats, such as the ovenbird and hooded warbler. Under all alternatives, road, pipeline, and drill pad construction would reduce existing mature forest habitat and increase the amount of edge in the project area. However, these hard mast/mature forest/old age forest habitat conditions will remain well connected over the 15-year period and forested travel corridors free from constant disturbance are maintained by road access closure. Forest fragmentation would be minimal given the narrow clearing widths for roads and pipelines and the small acreage disturbed when compared to the extensive surrounding unfragmented forests. Given the entire Clinch Ranger District is within a heavily (>70%) forested landscape, the expected negative impacts of edge are not considered significant.

Early seral habitat would be increased in all alternatives where roads and/or well pads are not allowed to redevelop into forest conditions. The increase in grass/forbs under all alternatives would provide food source for such species as whitetail deer, wild turkey, and indirectly for such species as the eastern towhee. While hard mast is reduced under all alternatives due to reduction of forested acres, hard mast production capability is still retained on adjacent acreage. It is likely that soft mast production (fruits and berries) will increase under all alternatives with plants such as blackberry, raspberry, and pokeweed occurring where land is cleared.

Numbers of snags will be reduced in all alternatives due to the number of acres on which forest will be cleared. Snag development generally takes 80 to 100+ years; therefore, even if cleared land is allowed to return to forest, it will take many decades for snags to develop once trees achieve a mature size and then die. However it is likely this loss of snags will be offset over time by increased tree mortality resulting from insect infestations such as gypsy moth and pine bark beetles.

Because of lease stipulations or conditions of approval on plans of operation, development activities would be excluded from riparian areas. This habitat would be maintained and riparian species such as the Acadian flycatcher should have little to no change.

A summary of expected effects to MIS are shown in Table 3-200.

THREATENED, ENDANGERED, AND SENSITIVE (TES) SPECIES

The majority of the Reasonably Foreseeable Development for oil and gas will occur on the Clinch Ranger District. A very small amount of exploratory activity may occur on the New Castle and New River Valley Districts. Therefore, this discussion will focus on the Clinch Ranger District. The Clinch Ranger District provides habitat for 6 federally threatened and endangered terrestrial species, which include 2 plants, 3 mammals and one bird. There are 25 terrestrial species designated by the Regional Forester as sensitive. Sensitive species include species occurring on the Forest with range-wide viability concerns, but which are not included on lists of endangered, threatened, proposed, or candidate species. Sensitive species receive special management emphasis in order to ensure their viability and to preclude trends toward federal listing or endangerment.

Forest terrestrial threatened, endangered, and sensitive species that might be affected by the oil and gas leases occur in two ecological sections: the Northern Ridge and Valley, and the Cumberland Mountains. Each of these sections contains distinct geologies and landforms, which give rise to a variety of unique habitats such as boreal forests, caves, wetlands, shale barrens, fire-adapted communities, glades, sinkholes, and springs. These unique habitats, in turn, support assemblages of rare plant and animal species. In addition to the habitat diversity found in the ecological sections, the Forest encompasses a wide range of latitude. Many plant and animal species more typically associated with northern or southern biomes reach the limit of their range on the Forest.

For the oil and gas leasing analysis, 40 aquatic threatened and endangered species listed on the Clinch Ranger District and 99 aquatic species designated by the Regional Forester as sensitive were considered (see Table 3-196). The Forest's aquatic threatened, endangered and sensitive species occur within the New, James, Roanoke, Holston, Clinch, Big Sandy, and Cumberland River watersheds. Each of these watersheds contains their own unique assemblages of aquatic species. On the Clinch Ranger District the Holston, Clinch, Big Sandy, and Cumberland River watersheds may be affected. Terrestrial threatened, endangered and sensitive species are listed in Table 3-201.

Federally Listed Species

Following is a brief description of each of the federally listed plant and animal species currently known to exist on the Clinch Ranger District along with current management strategies for recovery.

Small Whorled Pogonia (***Isotria medeloides)***. The Jefferson National Forest has 1 known colony with 10 plants of the small whorled pogonia. Stem counts of the species fluctuate widely year- to- year, a fact that makes viability assessment difficult and which is also noted in the 1992 Recovery Plan. This colony, discovered in 1994, is the only known site from Virginia’s Cumberland Plateau.

This species is found primarily in second and third-growth deciduous and mixed-

Table 3-200. Expected Population Trend of MIS over a 15-Year Period of Oil and Gas Lease/ Development Activity by Alternative. Population trend estimates are based on expected trends in habitat quantity and quality.

Common Name	Management Effects Indicated	A	B	D	E	F	G	I
Peaks of Otter salamander	TES species dependent on mature, moist hardwood forest	NA/NA	NA/NA	NA/NA	NA/NA	NA/NA	NA/NA	NA/NA
Pileated woodpecker	Snag-dependant wildlife species	=/-	=/-	=/-	=/-	=/-	=/-	=/-
Ovenbird	Mature forest interior species	=/-	=/-	=/-	=/-	=/-	=/-	=/-
Chestnut-sided warbler	High-elevation early successional species	=/=	=/=	=/=	=/=	=/=	=/=	=/=
Acadian flycatcher	Mature riparian forest-dependant species	=/=	=/=	=/=	=/=	=/=	=/=	=/=
Eastern towhee	Early successional forest wildlife species	=/+	=/+	=/+	=/+	=/+	=/+	=/+
Black bear	Meeting hunting demand for this species	=/=	=/=	=/=	=/=	=/=	=/=	=/=
Wild turkey	Meeting hunting demand for this species	=/+	=/+	=/+	=/+	=/+	=/+	=/+
White-tailed deer	Meeting hunting demand for this species	=/+	=/+	=/+	=/+	=/+	=/+	=/+
Hooded warbler	Mid-and late successional deciduous forest species, inc. mixed mesophytic, oak & oak-pine forests	=/-	=/-	=/-	=/-	=/-	=/-	=/-
Scarlet tanager	Upland oak forest species	=/-	=/-	=/-	=/-	=/-	=/-	=/-
Pine warbler	Mid-and late successional pine and pine-oak forest species	=/-	=/-	=/-	=/-	=/-	=/-	=/-
Wild trout (brook trout, rainbow trout, brown trout)	Cold-water streams and meeting fishing demand for these species	See discussion under "Aquatic Species"						

Population trend expressed as expected change from current levels following implementation of proposed action: "++" relatively large increase, "+" increase, "=" little to no change, "-" decrease, "- -" relatively large decrease.

Table 3-201. Federally Endangered (E), Threatened (T), Forest Service Sensitive (S) Terrestrial Species within the 5th Level HUC Watersheds where Federal Oil and Gas Development May Occur

Scientific Name	Common Name	G-Rank	Status
Arabis Hirsuta Var Adpressipilis	Hairy Rockcress	G5T4Q	
Arnoglossum Muehlenbergii	Great Indian-Plantain	G4	
Arrhopalites Carolynae	A Cave Springtail	G2G3	
Arrhopalites Commorus	A Cave Springtail	G1G2	
Botrychium Jenmanii	Alabama Grape-Fern	G3G4	
Brachoria Dentata	A Millipede	G1	
Cardamine Flagellifera	A Bittercress	G3	
Carex Purpurifera	Purple Sedge	G4?	
Cimicifuga Rubifolia	Appalachian Bugbane	G3	
Cleistes Bifaria	Small Spreading Pogonia	G3G4	
Cuscuta Coryli	Hazel Dodder	G5	
Cyclotrachelus Incisus	A Ground Beetle	G2	
Dendroica Magnolia	Magnolia Warbler	G5	
Euchloe Olympia	Olympia Marble	G4G5	
Eupatorium Incarnatum	Pink Thoroughwort	G5	
Gaylussacia Brachycera	Box Huckleberry	G3	
Hexastylis Shuttleworthii Var Shuttleworthii	Large-Flowered Heartleaf	G4T4	
Houstonia Canadensis	Canada Bluets	G4G5	
Isotria Medeoloides	Small Whorled Pogonia	G2	LT
Juncus Articulatus	Jointed Rush	G5	
Leucothoe Fontanesiana	Highland Dog-Hobble	G5	
Limnothlypis Swainsonii	Swainson's Warbler	G4	
Liparis Loeselii	Loesel's Twayblade	G5	
Magnolia Macrophylla	Bigleaf Magnolia	G5	
Melica Nitens	Three-Flower Melic Grass	G5	
Monotropsis Odorata	Sweet Pine Sap	G3	
Myotis Grisescens	Gray Bat	G3	LE
Myotis Leibii	Eastern Small-Footed Bat	G3	
Myotis Sodalis	Indiana Bat	G2	LE
Oligoneuron Rigidum Var Rigidum	Stiff Goldenrod	G5T5	
Paravitrea Septadens	Brown Supercoil	G1	
Phlox Amplifolia	Large-Leaved Phlox	G3G5	
Pseudanophthalmus Cordicollis	Little Kennedy Cave Beetle	G1	
Rhododendron Arborescens	Smooth Azalea	G4G5	
Rudbeckia Triloba Var Pinnatiloba	Pinnate-Lobed Black-Eyed Susan	G4G5T2	
Silene Rotundifolia	Roundleaf Catchfly	G4	
Spartina Pectinata	Freshwater Cordgrass	G5	
Spiraea Virginiana	Virginia Spiraea	G2	LT
Spiranthes Lucida	Shining Ladies'-Tresses	G5	
Stygobromus Cumberlandus	Cumberland Cave Amphipod	G2G3	
Stylophorum Diphyllum	Celandine Poppy	G5	
Synandra Hispidula	Gyandotte Beauty	G4	
Triphora Trianthophora	Nodding Pogonia	G3G4	

deciduous/coniferous forests. Ages of the older trees on the sites vary from as young as 30- years- old in South Carolina to 80-years-old in Virginia. The forest habitat in which this orchid is found is not rare, yet only a small percentage of the habitat has colonies of small whorled pogonia. Site characteristics are highly variable, but are usually mesic, with sparse to moderate ground cover and a relatively open understory canopy. Old logging roads or streams are often nearby. Many sites show signs of past agricultural use (USFWS 1992).

The primary threat to the small whorled pogonia throughout its range is habitat destruction by residential and commercial development. Collection of plants, recreational use, herbivory, and inadvertent damage from research activities are also cited as harming populations. Whereas heavy timbering and clear-cutting are considered threats, selective timbering may not be harmful to a population (U.S. Fish and Wildlife Service 1992).

The one small whorled pogonia site on the Forest is on a moderate north-by-northwest slope in a submesic second-growth black oak, chestnut oak, and red maple dominated forest. The plants occur in a transition area where the understory vegetation grades from dense ericaceous shrubs and galax on the upper slope to a more open area with scattered forbs and woody seedlings on the lower slope. The plants cover a roughly 25 square meter area. This site is protected within a Special Botanical – Zoological Area that is available for Federal oil and gas leasing with controlled surface use stipulations to protect small whorled pogonia and its habitat as well as other rare biological resources.

Virginia Spiraea (***Spiraea virginiana)***. Virginia spiraea is a southern Appalachian endemic occurring in the southern Blue Ridge and Appalachian Plateau physiographic provinces (Ogle, 1991). This species is a clonal shrub that reproduces completely or almost completely through vegetative means. Habitat is rocky, flood-scoured riverbanks in gorges or canyons, where woody competition is reduced and riverwash deposits create sites for vegetative propagule establishment (U.S. Department of the Interior, Fish and Wildlife Service 1990). NatureServe Explorer (2001) describes the habitat as periodically flood-scoured banks of high-gradient mountain streams or along lower stream reaches. Plants are often found on geologically active areas with erosion, deposition, and slumping, along rivers with dynamic flooding regimes, sandbars, scoured river shore and flatrock habitat with crevices. These areas also are associated with cobbles, boulders, and massive rock outcrops with sandy or clay soils. The areas can be periodically xeric. Plants are often seen in silt mud and sand.

Threats include reservoir construction (inundation of plants or alteration of natural flood regimes), human disturbance of riverbank habitats, and competing vegetation (U.S. Department of the Interior, Fish and Wildlife Service 1990).

On the Jefferson National Forest Virginia spiraea occurs at three sites:

Pound River. In 1987, 4 clumps of vigorous plants (Virginia Department of Conservation and Recreation 1996).

Chimney Cliffs/Russell Fork. 3 occurrences at this site, the largest is on Forest Service land. In 1995 this occurrence consisted of 25-30 clumps in a 10 X 15 meter area. Vigorous vegetation reproduction was taking place. The other two occurrences are in Breaks Interstate Park or private land (Belden, A. Jr. and W.H. Moorhead III 1996).

Guest River Gorge. In a 1993 survey, 100+ clumps in five subpopulations along about 1.1 mi. of river (Ludwig, J.C., A. Belden, and C.A. Clampitt 1994).

These sites are protected within Special Botanical and Zoological Areas that are available for Federal oil and gas leasing with controlled surface use stipulations to protect Virginia spiraea and its habitat as well as other rare biological resources.

Indiana bat (***Myotis sodalis)***. The distribution of Indiana bats is generally associated with limestone caves in the eastern U.S. (Menzel et al. 2001). Within this range, the bats occupy two distinct types of habitat. During summer months, maternity colonies of more than 100 adult females roost under sloughing bark of dead and partially-dead trees of many species, often in forested settings (Callahan et al. 1997). Reproductive females may require multiple alternate roost trees to fulfill summer habitat needs. Adults forage on winged insects within three miles of the occupied maternity roost. Swarming of both males and females and subsequent mating activity occurs at cave entrances prior to hibernation (MacGregor et al. 1999). During this autumn period, bats roost under sloughing bark and in cracks of dead, partially-dead and live trees.

Wintering colonies occupy very specific climatic regimes in cool, humid caves or mines primarily west of the Appalachian Mountains (Barbour and Davis 1969; Menzel et al. 2001). Few sites provide these conditions, and approximately 85% of the species inhabits only nine caves or mine shafts (Menzel et al. 2001; USDI FWS 1999).

Although most hibernacula have been protected, the Indiana bat still appears to continue a 5% decline in range-wide population every two years (Cochran et al. 2000). Causes of decline are not known and have continued despite efforts to protect all known major hibernacula. Researchers are focusing studies on land use practices in summer habitat, heavy metals, pesticides and genetic variability in attempts to find causes for the declines.

Recommended habitat management includes protecting known significant hibernacula from human impacts, retaining forested condition around the entrances to significant hibernacula, and evaluating opportunities to protect Indiana bats through land acquisition (Menzel et al. 2001).

It is difficult to quantify summer roosting habitat for Indiana bat at a range-wide, regional or local level due to the variability of known roost sites and lack of knowledge about landscape scale habitat characteristics. Forest management practices that affect occupied roost trees may have local impacts on Indiana bat populations. However, the bats live in highly altered landscapes, depend on an ephemeral resource--dead and dying trees--and may be very adaptable. Anecdotal evidence suggests that these bats may respond positively to some degree of habitat disturbance (USDI FWS 1999).

Several caves on the Forest have been known to support Indiana bats, at least historically. Steps have been taken by the Forest to protect these caves for the Indiana bat. Both males and females hibernate in large caves and mine tunnels. In 1995, bat gates were installed in several caves on the Forest. These caves are Shire's Saltpetre Cave on the New Castle Ranger District, and Kelly Cave and Cave Springs Cave on the Clinch Ranger District. Shire's Saltpetre Cave and Kelly Cave are the only caves on the Forest known to have been hibernacula for Indiana bats, at least historically. Cave Springs Cave is not currently known to be a hibernaculum for any rare bat species, but it has the potential to serve as a hibernaculum. In addition, Cave Springs Cave is known to contain a variety of troglobitic amphipods and isopods.

Both forest-wide standards and a specific management prescription surrounding Indiana bat hibernacula are designed to protect roosting and foraging habitat as well as the hibernacula for the Indiana bat. The primary cave protection area is administratively unavailable for Federal oil and gas leasing. The secondary cave protection area is available for leasing with controlled surface use stipulations to protect Indiana bat habitat.

Bald Eagle (***Haliaeetus leucocephalus)***. The bald eagle ranges over most of the North American continent, from as far north as Alaska and Canada, down to Mexico. Experts believe that in 1782 when the bald eagle was adopted as our national bird, their numbers may have ranged from 25,000 to 75,000 nesting pairs in the lower 48 states. Since that time the species has suffered from habitat destruction and degradation, illegal shooting, and most notably from contamination of its food source by the pesticide DDT. In the early 1960's, only 417 nesting pairs were found in the lower 48 states. In 1999, more than 5,748 nesting pairs of bald eagles were recorded for the same area, resulting primarily from the banning of DDT in the United States in 1972 aided by additional protection afforded under the Endangered Species Act (USDI, Fish & Wildlife Service, 1999).

Bald eagles have few natural enemies but usually prefer an environment of quiet isolation from areas of human activity (i.e. boat traffic, pedestrians, or buildings), especially for nesting. Their breeding areas are generally close to (within 4 km) coastal areas, bays, rivers, lakes, or other bodies of water that reflect general availability of primary food sources including fish, waterfowl, rodents, reptiles, amphibians, seabirds, and carrion (Andrew and Mosher 1982, Green 1985, Campbell et al. 1990). Although nesting territory size is variable, it typically may encompass about 2.59 square kilometers (Abbott, 1978). Most nest sites are found in the midst of large wooded areas adjacent to marshes, on farmland, or in logged-over areas where scattered seed trees remain (Andrew and Mosher, 1982). The same nest may be used year after year, or the birds may alternate between two nest sites in successive years. Bald eagles mate for life and are believed to live 30 years or more in the wild. Breeding bald eagles in Virginia appear to be permanent residents, whereas the young disperse extensively northward and southward. Although bald eagles may range over great distances, they usually return to nest within 100 miles of where they were raised (USDI, Fish & Wildlife Service, 1995).

Winter home ranges for eagles can be very large, especially for non-breeding birds. They generally winter throughout the breeding range but are more frequent along the coast. These birds commonly roost communally.

The primary threats to the bald eagle include loss of nesting, foraging, and roosting habitat especially along shorelines, disturbance by humans, biocide contamination, decreasing food supply, and illegal shooting (Byrd and Johnstone, 1991, Buehler, D.A. et al, 1991). Bald eagles also have died from lead poisoning as a result of feeding on waterfowl that had inadvertently ingested lead shot. In 1991, the U.S. Fish and Wildlife Service completed a program to phase out lead shot for waterfowl hunting.

Timber harvesting or road building activities have the potential to impact the bald eagle or its habitat should it occur near streams, lakes, or other wetlands. Human disturbance from roads, trails, and campgrounds can also adversely affect the use of an area for nesting or roosting by eagles.

The Draft Forest Plan and all alternatives include a standard establishing 1500-foot protection zones around bald eagle nests and communal roost sites. Vegetation management that would affect forest canopy within these zones is prohibited, and other activities that may disturb eagles are prohibited within these zones during periods of use. The Riparian Prescription, with its emphasis on low levels of disturbance and maintenance of mature forest, provides direction for management of shorelines where bald eagles may forage. This direction also would be the same across all alternatives. No additional specific provisions related to foraging habitat are included; due to the variety of circumstances that may be involved, these issues would be addressed during site-specific analysis.

Blackside dace (***Phoxinus cumberlandensis)***. The blackside dace was listed as threatened in 1987. Historically, the blackside dace likely inhabited many of the small, moderate gradient cool water streams in the upper Cumberland River system in Kentucky and Tennessee. The species has declined so it now occurs in about 35 short stream stretches. The species is found near the Jefferson National Forest in the Poor Fork of the Cumberland River, Kentucky. In addition, blackside dace specimens collected earlier from Cox Creek were confirmed in 2001. This is significant, since Cox Creek is a tributary to the North Fork of the Powell River (Hylton, personal communication 2002), making this the first record within the Tennessee drainage. Since then, it has been collected from other areas in the North Fork Powell system. Genetics work is currently being conducted to try to determine the origin of this species in the Tennessee drainage. These new occurrences are adjacent to National Forest land, and it is expected that nearby tributaries also contain blackside dace. Populations on or near National Forests are displayed in Table 3-58.

Blackside dace inhabit cool, small, upland streams with moderate flow. The fish is generally associated with undercut banks and large rocks, and it is usually found within well-vegetated watersheds with intact riparian areas. Blackside dace feed on algae, diatoms, and small invertebrates. Spawning occurs in May over the nests of other fish in gravel run areas.

The decline of this species is linked to siltation from coal mining and other ground disturbing activities, water quality degradation including acid mine drainage, impoundments, and residential development. Competition with the introduced southern redbelly dace may have displaced blackside dace from the warmer waters within its range.

Roanoke logperch (***Percina rex)***. The Roanoke logperch was federally listed as endangered in 1989. It is confined to the Roanoke and Chowan drainages of Virginia; the populations are small and separated by wide river gaps or large impoundments. In the Valley and Ridge Province (nearest Forest Service land), P. rex is contiguously distributed in the upper Roanoke River and its lower North and South forks, and is known from lower Mason and Tinker creeks. Almost always rare or uncommon, never abundant; the largest population occupies the upper Roanoke River from Roanoke city into the lower reach of its main forks (Jenkins and Burkhead, 1993). Although this fish is not known to occur on National Forest, it is found approximately 2-3 miles downstream from the Forest boundary. Populations on or near National Forests are displayed in Table 3-61.

This species inhabits medium-sized streams that are warm, usually clear, and have moderate to low gradient. Young and small juveniles usually occupy slow runs and pools, most frequently sandy areas. During warmer months, adults typically dwell on gravel and rubble in riffles, runs, and pools (Jenkins and Burkhead, 1993).

The upper-most Roanoke drainage population of Roanoke logperch, perhaps the only strong one, occupies a small area that is continually encroached upon by industrial, residential, and agricultural development. Segments of the population are jeopardized by a proposed water-supply impoundment and a channelization project (U.S. Fish and Wildlife Service 1992).

Cumberland Johnny darter (***Etheostoma susanae)***. The Cumberland Johnny darter was designated as a candidate for federal listing in 2001. It is a narrow endemic species, known from the Cumberland River drainage above Cumberland Falls, eastern Kentucky and adjacent Tennessee. The Jefferson National Forest ownership extends into the Poor Fork of the Cumberland drainage in Kentucky. Previous records of this species in the Poor Fork portion of the Cumberland River drainage in Letcher and Harlan counties, Kentucky (Starnes and Starnes 1979), have been determined to be the Johnny darter (E. nigrum) based on a genetics study conducted by Strange (1998). However, Starnes (pers. comm. 2002) feels that it is likely the Cumberland Johnny darter is within the Poor Fork, and further sampling and genetic testing of those fish is necessary. Populations on or near

National Forests are displayed in Table 3-59.

This species is found in shallow water in low velocity shoals and backwater areas of moderate gradient stream reaches with stable sand or sandy-gravel substrata. It is not found in areas with cobble or boulder substrata.

The population of Cumberland Johnny darter in the Poor Fork Cumberland is located in the only suitable habitat for this species on the Jefferson National Forest. The status of this population is undetermined on National Forest in this watershed, and further sampling is necessary.

Though recorded as abundant by Jordan and Swain (1883), this fish is now considered to be rare and extremely restricted in range. The 16 known surviving occurrences are restricted to short stream reaches, and thought to form six population clusters that are isolated from one another by poor quality habitat, impoundments, or natural barriers. Siltation, primarily from coal mining activities, but also from forestry and agricultural activities, road construction, and urban development, appears to be the major factor contributing to the decline of the Cumberland Johnny darter.

Duskytail darter (***Etheostoma percnurum)***. The duskytail darter was federally listed as endangered in 1993. The species is endemic to the upper Tennessee and Cumberland River systems. Four extant populations persist: 1) Little River in Blount County, TN; and 2) Citico Creek in Monroe County, TN on the Cherokee National Forest; 3) Big South fork of the Cumberland River in Scott County, TN; and 4) Copper Creek and Clinch River in Scott County, VA. A population of duskytail darters has been established into Abrams Creek in the Great Smoky Mountains National Park from progeny of the Citico Creek population. An experimental population of duskytail darters has been authorized for the Tellico River in Monroe County, TN on the Cherokee National Forest. Stocking will begin in 2003. Populations near Jefferson National Forest are displayed in Table 3-60.

This species is found in rocky areas with moderate to fast current in large creeks and large rivers. Slab rocks, free from sediment, are essential for nesting as well as hiding cover. The eggs are attached to the under side of the slab rock and the male remains with the nest guarding the eggs. Food items include midge larvae, mayfly nymphs, and microcrustaceans. Sight feeding is probably important.

The decline and extirpation of most populations of duskytail darters may be attributed to the general deterioration of water quality resulting from siltation from logging, mining, and waste discharges. The relic populations are isolated by reservoirs. Because of its limited range this species is vulnerable to catastrophic events such as accidental toxic chemical spills. The long-term viability of this species may be threatened by the absence of natural gene flow among its isolated populations.

Slender chub (***Erimystax cahni)***. The slender chub was listed as a threatened species in 1977. Critical habitat was designated as: Powell River main channel from the backwaters of Norris Lake in Tennessee, upstream through Lee County, Virginia; and Clinch River from the backwaters of Norris Lake upstream through Scott County, Virginia.

It is endemic to the upper Tennessee River system in Tennessee and Virginia. Historically, the species is known from 3 rivers in the drainage, the Clinch, Powell, and Holston Rivers. The slender chub is thought to be extirpated from the Holston River but is still known in low numbers from the Clinch River in Tennessee and the Powell River in Tennessee and Virginia, about 10 miles downstream of the Jefferson National Forest. Populations on or near National Forests are displayed in Table 3-62.

SOCIAL AND ECONOMIC DEVELOPMENT

MINERAL RESOURCES

FEDERAL OIL AND GAS REASONABLY FORESEEABLE DEVELOPMENT SCENARIO (RFD)

The slender chub is a large river species and it is restricted to moderately to fast flowing flats and shoals composed of pea-sized gravel. Slender chubs occasionally occupy slow runs but have never been found in backwater or pool habitat. The species feeds on aquatic insect larvae and small mollusks. Spawning is thought to occur in the spring.

Siltation, dredging, pollution, water withdrawl, and impoundment are threats to the habitat of the slender chub. The pea-size gravel substrate utilized by the fish is particularly vulnerable to destruction by siltation. Coal fines are a problem in the Powell River.

Spotfin chub (***Cyprinella monacha Erimonax monacha***). The spotfin chub was federally listed as threatened in 1977. The species is endemic to the Tennessee River where it was widely distributed in major tributaries. Only four extant populations persist: 1) Little Tennessee River system in North Carolina; 2) Duck River in Tennessee; 3) Emory River in Tennessee; and 4) the North Fork of the Holston River in Virginia. These populations do not occur on or near the National Forests currently (2002) undergoing Forest Plan revision. A population of spotfin chubs has been established into Abrams Creek in the Great Smoky Mountains National Park (GSMNP). An experimental population is authorized in the Tellico River in Monroe County, TN on the Cherokee National Forest. Stocking will begin in 2002. All of the populations are isolated by reservoirs. Populations near Jefferson National Forest are displayed in Table 3-63.

This species is found in large sized streams in slow to swift current over substrates free of sedimentation. As with most minnows, this species uses schooling for evasion of predators. Eggs are laid in a crack in a rock; no parental care is provided. Spotfin chubs are diurnal feeders. Food includes aquatic insects, which is located through sight and tactile stimuli.

The decline and extirpation of most populations of spotfin chubs may be attributed to the general deterioration of water quality resulting from impoundments, coldwater releases from dams, inundation of habitat by reservoirs, siltation from mining (especially coal mines), and waste discharges.

Yellowfin madtom (***Noturus flavipinnis***). The yellowfin madtom was federally listed as threatened in 1977. The species is endemic to the Tennessee River system up stream of Chattanooga, TN. Only three extant populations persist: 1) in Citico Creek in Monroe County, TN on the Cherokee National Forest; 2) Powell River in Hancock County, TN; and 3) Copper Creek in Scott and Russell counties, VA. They were historically known from the North Fork Holston River downstream of the Jefferson National Forest. A population of yellowfin madtoms has been established into Abrams Creek in the Great Smoky Mountains National Park (GSMNP) from progeny of the Citico Creek population. An experimental population is authorized in the Tellico River in Monroe County, TN on the Cherokee National Forest. Stocking will begin in 2003. Populations near Jefferson National Forest are displayed in Table 3-64. The following locations in Copper Creek are near, but not within a watershed where the Forest manages land.

This species is found in small to medium sized streams with moderate current free of sedimentation. Cover, especially, flat slab rocks, is essential for nesting as well as hiding. The eggs are laid in a clutch under the slab rock and guarded by the male. Feeding usually occurs at night. Food includes aquatic invertebrates. Sight, tactile and chemical stimuli are used to locate food.

The greatest threat to the Citico Creek population is an accidental chemical spill that could destroy the entire population. Two other significant threats are sedimentation from ground disturbing activities (especially vehicles, horses, and people compacting and denuding the stream banks); and habitat destruction from recreational swimmers who pile slab rocks in the streams to create dams with deep pools. The slab rocks are essential to yellowfin madtoms for spawning and cover. The deep, slow flowing pools are not quality habitat for this species. The populations are isolated from the each other by reservoirs. In addition, Anakeesta shale formations in the Citico creek watershed are a potential source of heavy metals and acidity when exposed to air and precipitation by activities such as road construction.

James spinymussel (***Pleurobema collina***). The James spinymussel was federally listed as endangered in 1988. Historically, this species was apparently throughout the James River above Richmond, in the Rivanna River, and in ecologically suitable areas in all the major upstream tributaries (Clarke and Neves 1984). The species remained widespread through the mid-1960's, but now appears extirpated from 90% of the historic range. Extant populations and historical habitats on or near the National Forest are displayed in Table 3-75.

This species is found in slow to moderate currents over stable sand and cobble substrates with or without boulders, pebbles, or silt (Clarke and Neves 1984). Hove and Neves (1994) found James spinymussels in 1.5 to 20 m wide second and third order streams at water depths of 0.3 to 2 m. Seven fish hosts, all in the family Cyprinidae, have been identified (Hove 1990): bluehead chub, rosyside dace, blacknose dace, mountain redbelly dace, rosefin shiner, satinfin shiner, and stoneroller. Freshwater mussels are filter feeders taking organic detritus, diatoms, phytoplankton, and zooplankton from the water column. The following excerpt from Hove and Neves (1994) states the current thinking on threats:

"There are several anthropogenic and natural threats to the James spinymussel's continued existence. Nearly all the riparian lands bordering streams with the James spinymussel are privately owned. With more intensive use of the land, it is probable that water quality and habitat suitability will deteriorate. At present, the most detrimental activities include road construction, cattle grazing, and feed lots that often introduce excessive silt and nutrients into the stream."

The introduced Asian clam is also considered to be a threat to the James spinymussel and is beginning to invade several sites (Hove and Neves 1994).

Despite extensive searches on the Jefferson National Forest, the James spinymussel has been confirmed at only one site. This consisted on one live specimen found in 1990 (O'Connell and Neves 1991). A subsequent survey in 2001 failed to locate any live specimens at this site. Based on this information it is uncertain that the Forest supports a viable population of James spinymussel. The main avenues for the Forest to aid in this species recovery are through land acquisition, assisting in augmentation efforts, and working with landowners to protect streams and streamside habitat.

Appalachian monkeyface (***Quadrula sparsa***). The Appalachian monkeyface was federally listed as endangered in 1983 (Distribution information from NatureServe (2002)).

Historically thought to have been widespread in the tributaries of the upper Tennessee and Cumberland River systems. Distributional records became confused when Ortmann lumped SPARSA and TUBEROSA under INTERMEDIA (Bogan and Parmalee, 1983). Currently restricted to free-flowing reaches of the Powell and Clinch rivers above Norris Reservoir in Tennessee (USFWS, 1984) and in one section of the Powell and Clinch rivers in Virginia (Neves, 1991). Present and historical habitat near the National Forest is displayed in Table 3-65.

The Appalachian monkeyface has been found inhabiting a sand and gravel substrate in riffles and shallow shoal areas with moderate current (Parmalee and Bogan 1998). Fish

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hosts are unknown. Threats to the Appalachian monkeyface include impoundments, siltation and pollution (NatureServe 2002).

Birdwing pearlymussel (***Lemiox rimosus***). The birdwing pearlymussel was federally listed as endangered in 1976. Distribution information from NatureServe (2002):

The birdwing pearlymussel is currently known from the Clinch, Powell, Elk, and Duck Rivers in Tennessee and Virginia. Historically, it was known throughout Tennessee River drainage, but absent from Cumberland River (Terwilliger, 1991). Present and historical habitat near the National Forest is displayed in Table 3-66.

The birdwing pearlymussel is a lotic, riffle-dwelling species that usually occurs in moderate to fast flowing water of shallow to moderate (6 feet) depth. It resides in stable, silt-free substrates of mixed particle size ranging from sand to cobble. Fish hosts include the banded darter and greenside darter (Parmalee and Bogan 1998), and possibly the mirror shiner, spotfin shiner, and whitetail shiner (USFWS 1993).

Threats to the birdwing pearlymussel include pollution, habitat alteration impoundments, siltation from mining, channelization); introduced Asian clam (southwestern Virginia); The largest population in the Duck River is threatened by the Tennessee Valley Authority's Columbia Dam Project; is extirpated from impounded sections of other rivers (NatureServe 2002).

Cracking pearlymussel (***Hemistena lata***). The cracking pearlymussel was federally listed as endangered in 1991. Distribution information from NatureServe (2002):

The cracking pearlymussel originally inhabited the Ohio, Cumberland, and Tennessee River systems. It has been extirpated from most of its former range but some viable populations may persist in the upper Clinch River in Tennessee (Parmalee and Bogan 1998). Present and historical habitat near the National Forest is displayed in Table 3-67.

The cracking pearlymussel is a lotic, riffle-dwelling species, occurring at fords and shoals with sand and gravel substrates and moderate current velocities. It can burrow deep into the river bottom because of an unusually long foot and is, therefore, difficult to collect. It usually occurs in less than two feet of water and spends most of its life deeply buried in substrate (Parmalee and Bogan 1998). Fish hosts are the rock bass, banded sculpin, whitetail shiner, central stoneroller, streamline chub, striped shiner, margined madtom, greenside darter, and bluebreast darter (Jones and Neves 2000).

Threats to the cracking pearlymussel include impoundments, siltation and pollution leading to water quality and habitat deterioration, inadequate sewage treatment, coal mining, oil and gas drilling and poor land-use practices (NatureServe 2002).

Cumberland bean (***Villosa trabalis***). The Cumberland bean was federally listed as endangered in 1976. The species is endemic to the tributary streams of the Tennessee and Cumberland River systems. Four extant populations persist. Three are in the tributaries to the middle Cumberland River: 1) the Little South Fork River; 2) Buck Creek; and 3) Rockcastle River. The forth population is in the Hiwassee River in Polk County, TN on the Cherokee National Forest. Present and historical habitat near the Jefferson National Forest is displayed in Table 3-68. This mussel was formerly known from streams in the upper Tennessee drainage, but is thought to be extinct from Virginia.

This species is found in large streams and small rivers in fast current with gravel or sand and gravel substrate. Fish hosts include: arrow darter, barcreek darter, fantail darter, Johnny darter, rainbow darter, snubnose darter, sooty darter, striped darter, and stripetail darter. Freshwater mussels are filter feeders taking organic detritus, diatoms, phytoplankton, and zooplankton from the water column.

The decline and extirpation of most populations of Cumberland bean may be attributed to dam construction and impoundments. Siltation from logging, mining, agriculture and construction; organic and inorganic pollutants from industrial, agricultural, and other point and non-point sources; and habitat loss do to channelization and dredging have aggravated the situation for the surviving populations.

Cumberland monkeyface (***Quadrula intermedia***). The Cumberland monkeyface was federally listed as endangered in 1982. Distribution information from NatureServe (2002):

Historically widespread in the upper Tennessee River system and possibly in the Cumberland River system. Since 1960, found in the Duck, Clinch, Elk and Powell rivers. Since 1970 found in the Clinch, Powell and Tellico rivers. It was recently found alive in the Duck River in Tennessee. Except for a possible small population in the Duck and Elk Rivers (TN), the last remaining local populations of the Cumberland monkeyface are to be found in the upper Powell River from the VA-TN border upstream to White Shoals, Lee County (Parmalee and Bogan 1998). Present and historical habitat near the National Forest is displayed in Table 3-69.

The Cumberland monkeyface is a lotic, fast water species, usually occurring in riffles and runs of small to mid-sized rivers. It has never been found in small streams of impounded portions of rivers. This species is typically well burrowed in stable substrates, and occupies the same macro habitats as the other endangered mussel species in the Powell River, Lee County, VA.

Threats to the Cumberland monkeyface include habitat alteration such as pollution, impoundment, siltation, and channelization (NatureServe 2002). Fish hosts for this mussel include the streamline chub and blotched chub (Parmalee and Bogan 1998).

Cumberlandian combshell (***Epioblasma brevidens***). The Cumberlandian combshell was federally listed as endangered in 1997. Distribution information from NatureServe (2002):

Historically, distributed throughout the Cumberlandian region of the Tennessee and Cumberland River systems. Populations are currently known from Buck Creek in Kentucky; through a few miles of the Big South Fork Cumberland River in Kentucky and Tennessee; and in very low numbers in the Powell and Clinch Rivers in Virginia and Tennessee (U.S. Fish and Wildlife Service 1997). A few, likely non-reproducing, populations associated with sub-lotic sections of some reservoirs (e.g., Old Hickory Reservoir on the Cumberland River). In 1997 several fresh dead specimens were found by Jeff Garner in Bear Creek, a tributary of the Tennessee River in northwestern Alabama and according to Tom Mann (Mississippi Natural Heritage Program) fresh dead shells were found in Mississippi in September 2000. Present and historical habitat near the National Forest is displayed in Table 3-70.

The Cumberlandian combshell has been collected in about two feet of water on a sand and gravel substrate in the Clinch River. Other reports indicate this species is found in moderate sized, clear streams with rocky bottoms. It appears to be absent in the smaller tributaries (Parmalee and Bogan 1998). Fish hosts are the banded sculpin, greenside darter, logperch, redline darter, spotted darter, Tennessee snubnose darter, and the wounded darter.

Threats to the Cumberlandian combshell include impoundments, channelization, siltation, and pollution (U.S. Fish and Wildlife Service 1998). NatureServe (2002) states: “Much of its former habitat has been inundated by reservoirs and considerable other portions have been devastated by acid mine run-off. Various forms of pollution and poor land use practices (e.g., siltation) threaten survival of remaining EOs [element occurrences]."

Dromedary pearlymussel (***Dromus dromas***). The dromedary pearlymussel was federally listed as endangered in 1976. NatureServe (2002) describes the historic and current distribution of this species:

Known from the Cumberland and Tennessee River systems in Tennessee and Virginia. Once common throughout the Tennessee River system. Currently known from the middle Cumberland River in Smith County, Tennessee; the Tennessee River in Meigs County, Tennessee; and in the upper Powell and Clinch rivers in Tennessee and Virginia (Parmalee and Bogan 1998). Present and historical habitat near the National Forest is displayed in Table 3-71.

The dromedary pearlymussel has been collected in the upper Powell and Clinch Rivers in shoals and riffles on gravel and sand substrates in about three feet of water (Parmalee and Bogan 1998). A possible fish host is the gilt darter.

Threats to the dromedary pearlymussel are not clearly understood, but probably include impoundments, siltation, and pollution (U.S. Fish and Wildlife Service 1983). NatureServe (2002) lists the following as threats to this species: impoundments, siltation and pollution leading to water quality and habitat deterioration, inadequate sewage treatment, coal mining, oil and gas drilling and poor land-use practices.

Fanshell (***Cyprogenia stegaria***). The fanshell was federally listed as endangered in 1990. The following is from NatureServe 2002 regarding the distribution of the fanshell:

It was historically widely distributed in the Tennessee, Cumberland, and Ohio River systems, although it has become very rare in recent years. In the Ohio drainage it has been recently found in: the deep channel of the Ohio River between Cincinnati and Pittsburgh (Johnson, 1980); the lower Muskingum and Walhonding Rivers, Ohio (Stansbery, et al. 1982); the Salt and Licking Rivers, tributaries of the Ohio (Stansbery, pers. comm.); the Green River, Kentucky (Biggins, 1991) the Kanawha River, West Virginia (Stansbery, pers. comm.); the Allegheny River, Pennsylvania (Dennis, 1970); and the lower Clinch River in Scott County (Neves, 1991). Present and historical habitat near the National Forest is displayed in Table 3-72.

This species is considered a big river species, but may inhabit shallow, unimpounded upper reaches of the Clinch River (Parmalee and Bogan 1998). Fish hosts are unknown. Threats to the fanshell include impoundments, navigation projects, pollution, and habitat alterations, such as gravel and sand dredging. These activities directly affected the species and/or reduced or eliminated its fish host (U.S. Fish and Wildlife Service 1991).

Fine-rayed pigtoe pearlymussel (***Fusconaia cuneolus***). The fine-rayed pigtoe pearlymussel was federally listed as endangered in 1976. Distribution information from NatureServe (2002):

Historically widespread in tributaries of the Tennessee River system in Tennessee (above the Mussel Shoals area), Virginia, and Alabama. It currently persists in portions of the Clinch and Powell rivers, the North Fork of the Holston, and in the Paint Rock River. The largest population resides in the Clinch River but it is reproductively isolated from the Powell River population (Neves, 1991). Present and historical habitat near the National Forest is displayed in Table 3-73.

The fine-rayed pigtoe pearlymussel is typically found in riffles in ford and shoal areas of rivers with moderate gradient (Parmalee and Bogan 1998). Fish hosts are the central stoneroller, fathead minnow, mottled sculpin, river chub, telescope shiner, Tennessee shiner, white shiner, and whitetail shiner.

Threats to the fine-rayed pigtoe pearlymussel include impoundments, channelization, siltation, and pollution (U.S. Fish and Wildlife Service 1984). NatureServe (2002) states that this species: "Has declined due to impoundments, siltation, and pollution. The remnant population in the Powell River may be threatened by oil and gas drilling and coal mining (Neves, 1991). The Clinch River population was reduced by toxic discharges and spills prior to 1972. The invasion of the Asian clam, and the possible invasion of the zebra mussel, also threaten remaining populations."

Green-blossom pearlymussel (***Epioblasma torulosa gubernculum***). The green-blossom pearlymussel was federally listed as endangered in 1976. This subspecies has been extirpated throughout its range and is possibly extinct. A live individual was last observed in 1984 in the Clinch River. Repeated visits to the site have produced only relicts. The only remaining subspecies of *E. torulosa* is *E. torulosa rangiana* found in the upper Ohio drainage (NatureServe 2002).

This subspecies is the headwater form of *E. torulosa* that once inhabited the larger rivers of the Interior Basin. Ortmann reported it from the Tennessee, Nolichucky, Holston, Clinch and Powell Rivers (see Recovery Plan for table of historical records). Present and historical habitat near the National Forest is displayed in Table 3-74.

The green-blossom pearlymussel was found in riffle areas with swift currents on a substrate of coarse sand and gravel to a substrate of firmly packed fine gravel, typically in shallow water. It has been collected in water varying from a few inches to six feet (Parmalee and Bogan 1998). Fish hosts are unknown. Threats to the green-blossom pearlymussel include impoundments, channelization, siltation, and pollution (U.S. Fish and Wildlife Service 1983).

Little-wing Pearlymussel (***Pegias fibula***). The little-wing pearlymussel was federally listed as endangered in 1988. Historically, this species occurred in many of the moderately high gradient, small to medium tributaries of the Tennessee and Cumberland Rivers systems in Alabama, Kentucky, Tennessee, North Carolina, and Virginia. Currently this species is only now known from Kentucky, Tennessee, and Virginia (U.S. Fish and Wildlife Service 1989). Several sites are known from Virginia: North Fork Holston River, Washington County, Big Moccasin and Copper Creeks, Scott County. Present and historical habitat near the National Forest is displayed in Table 3-76.

This species is typically found in cool, clear high gradient streams. Located on top of, or partially embedded in, sand and fine gravel between cobbles in 6 to 10 inches of water, often at the head of riffles (Parmalee and Bogan 1998). Possible fish hosts are greenside darter, emerald darter, banded sculpin and redline darter.

Threats to the little-wing pearlymussel are coal mining, and gas and oil development in the upper Cumberland and Powell River basins. Additional impacts have been caused by reservoir construction, poor land use practices, and urbanization that have caused excessive siltation and pollution throughout the species range (U.S. Fish and Wildlife Service 1989).

Oyster mussel (***Epioblasma capsaeformis***). The oyster mussel was federally listed as endangered in 1997. Distribution information from NatureServe (2002):

Historically, this species was distributed throughout the Cumberlandian region of the Tennessee and Cumberland River drainages in Alabama, Kentucky, Tennessee, and Virginia. Currently, in the Cumberland River drainage, remnant populations are found in Buck Creek and the Big South Fork Cumberland River in Kentucky and Tennessee. In the Tennessee River drainage, remnant populations are scattered through sections of the upper Clinch and Powell rivers in Tennessee and Virginia, and the Duck River in Tennessee. Although it has not been seen in recent years in the lower Nolichucky and Little Pigeon rivers in Tennessee it may still persist in low numbers (U.S. Fish and Wildlife Service 1997). It is believed to be extirpated from Alabama and potentially from Copper Creek in Virginia (Fraley and Ahlstedt 1999). Present and historical habitat near the National Forest is displayed in Table 3-77.

The Oyster mussel has been found in shallow riffles in fast water less than three feet in depth on gravel and sand substrates. Fish hosts are the banded sculpin, dusky darter, redline darter, spotted darter, and the wounded darter.

Threats to the Oyster mussel include impoundments, channelization, siltation, and pollution (U.S. Fish and Wildlife Service 1998). NatureServe (2002) states: “Much of its former habitat has been inundated by reservoirs and considerable other portions have been devastated by acid mine run-off. Various forms of pollution and poor land use practices (e.g., siltation) threaten survival of remaining EOs [element occurrences].”

Pink Mucket Pearlymussel (***Lampsilis abrupta***). The pink mucket pearlymussel was federally listed as endangered in 1976. Historically, this species occurred in the Mississippi, Ohio, Cumberland, and Tennessee Rivers. In the Tennessee River it occurred up to the lower Clinch River where it is very rare (Parmalee and Bogan 1998). Although several valves were found at Pendleton Island, Virginia in the Clinch River in the 1980’s (Neves pers. comm.) this species is considered extirpated from the state (NatureServe 2002). Historical habitat near the National Forest is displayed in Table 3-78.

This species is typically found in medium to large rivers on substrates ranging from silt and sand to gravel, rubble, and boulders. In the Clinch and Holston Rivers, however, it has been collected from areas of less than three feet of water on rocky substrates. Fish hosts are freshwater drum and sauger.

Threats to the pink mucket pearlymussel include modification of habitat (e.g., dams and dredging), degradation of water quality, and over harvest by commercial mussel industry as well as siltation, pollution, and channelization in Ohio (NatureServe 2002). The introduced zebra mussel may also be a threat.

Purple bean (***Villosa perpurpurea***). The Purple bean was federally listed as endangered in 1997. Distribution information from NatureServe (2002):

Historically distributed throughout the upper Tennessee River system above the confluence with the Clinch River. Presently occurs in portions of the Clinch River, Indian Creek, Copper Creek, and Beech Creek in northeastern Tennessee and southwestern Virginia. It has been extirpated from the Powell, North Fork Holston, Emory rivers and a portion of the upper Clinch River (U.S. Fish and Wildlife Service 1998). Present and historical habitat near the National Forest is displayed in Table 3-79.

The purple bean is typically encountered in substrate of coarse sand and gravel that include some silt, in moderate to strong current, and at depths of less than three feet. It also occurs in rock piles and under large, flat rocks. Fish hosts are sculpin species, greenside darter, and the fantail darter (Parmalee and Bogan 1998).

Threats to the purple bean include chemical and organic pollution, urban development, coal mine effluent, siltation from agriculture and clear-cutting, and damming continue to impact this species (NatureServe 2002).

Rough rabbitsfoot (***Quadrula cylindrica strigillata***). The rough rabbitsfoot was federally listed as endangered in 1997. Distribution information from NatureServe (2002):

Historically was restricted to the Clinch, Powell, and Holston drainage systems. It still occurs in all three drainages but in limited areas with low populations (U.S. Fish and Wildlife Service 1997). It has been extirpated from the entire Holston River system (U.S. Fish and Wildlife Service 1998). Present and historical habitat near the National Forest is displayed in Table 3-80.

The rough rabbitsfoot occurs in small to medium sized streams, such as the upper Clinch and Powell, in clear, shallow water on gravel and sand substrates. Shoals and riffles near streambanks seem to be preferred (Parmalee and Bogan 1998). Fish hosts are the bigeye chub, spotfin shiner, and the whitetail shiner.

Threats to the rough rabbitsfoot include impoundments, channelization, siltation, and pollution (U.S. Fish and Wildlife Service 1998). NatureServe (2002) states: “Low population levels and few EOs [element occurrences] make this species extremely vulnerable. Impacted by chemical and organic pollution, toxic mine run-off, channel alteration and inundation, siltation from agriculture and clear-cutting, and possibly by collecting (non-commercial). The populations in the lower Clinch, Powell, and Holston river systems were extirpated by reservoirs (U.S. Fish and Wildlife Service 1997).”

Shiny pigtoe (***Fusconaia cor***). The shiny pigtoe was federally listed as endangered in 1976. Distribution information from NatureServe (2002):

Historically occurred throughout the Tennessee River drainage as far south as Muscle Shoals. Its current distribution is scattered over five rivers: the North Fork of the Holston in Virginia, the Clinch (from the Virginia-Tennessee border upstream to Nash Ford), the Powell (from the Virginia-Tennessee border upstream to Lee County, Tennessee), it has not been seen in the Elk River in Tennessee since 1980 and it is uncommon in the Paint Rock River in Alabama. Present and historical habitat near the National Forest is displayed in Table 3-81.

The shiny pigtoe is typically found in shoal and gravel substrates of clear streams with moderate to fast currents. (Parmalee and Bogan 1998). Known fish host is the whitetail shiner. Possible fish hosts are the common shiner, telescope shiner, and warpaint shiner.

NatureServe cites the following threats: “Threatened by habitat alteration and pollution from strip mine runoff and coal washing. Populations in the North Fork of Holston and Clinch rivers were reduced by toxic discharges and spills prior to 1972. Some sizable populations in the Elk River were destroyed by impoundment of Tims Ford Reservoir. The invasion of the Asian clam, and the possible invasion of the zebra mussel, also threaten remaining populations.”

Slabside pearlymussel (***Lexingtonia dolabelloides***). The slabside pearlymussel is designated as a candidate for federal listing. The species is endemic to the Tennessee River system. Extant populations persist in the Clinch, Powell, Elk, Duck, and Hiwassee (in Polk County, TN on the Cherokee National Forest) Rivers in Tennessee; in the North Fork and Middle Fork Holton Rivers in Virginia downstream of the Jefferson National forest; and in the Paint Rock River of Alabama. Present and historical habitat near the Jefferson National Forest is displayed in Table 3-82.

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This species is found in small streams to large rivers (Tennessee River) in moderately strong current with sand, fine gravel and cobble substrate. Fish hosts for the glochidia include the popeye shiner, rosyface shiner, telescope shiner, saffron shiner, silver shiner, and Tennessee shiner, smallmouth bass, rock bass, redbreast sunfish central stoneroller, whitetail shiner, streamline chub, striped shiner, warpaint shiner, rosefin shiner, rosyface shiner, and fantail darter (Jones and Neves 2000, Neves et al. 1996, and Parmalee and Bogan 1998). Freshwater mussels are filter feeders taking organic detritus, diatoms, phytoplankton, and zooplankton from the water column.

The decline and extirpation of most populations of slabside pearlymussel may be attributed to channel alterations, inundation by reservoirs, siltation by agriculture and clear-cutting, chemical and organic pollution, and commercial clamming. Gravel mining activities are a threat in the Powell and Elk Rivers as well as coal mining activities. Passage of host fish may also be a factor.

Tan riffleshell (***Epioblasma florentina walkeri***). The tan riffleshell was federally listed as endangered in 1977. The species was widely distributed in the Cumberland and Tennessee River systems but only two extant populations persist: 1) in the Middle Fork of the Holston River (Smyth and Washington Counties, VA) down stream of the Jefferson National Forest; and 2) in the Hiwassee River on the Cherokee National Forest (Polk County, TN). Present and historical habitat near the Jefferson National Forest is displayed in Table 3-83.

This species is found in small to moderate sized rivers in riffles with coarse substrates. Water willow is often present. Habitat conditions also need to meet the requirements of sculpins and greenside, fantail, and redline darters which may serve as the host for the glochidia. Freshwater mussels are filter feeders taking organic detritus, diatoms, phytoplankton, and zooplankton from the water column.

The decline and extirpation of most populations of tan riffleshell mussels may be attributed to dam construction and impoundments. Siltation from logging, mining, agriculture and construction; organic and inorganic pollutants from industrial, agricultural, and other point and non-point sources; and habitat loss do to channelization and dredging have aggravated the situation for the surviving populations.

REGIONAL FORESTER'S SENSITIVE SPECIES

The objective of sensitive species designation is to ensure that Forest Service actions do not contribute to loss of viability of any native or desired non-native species or contribute to trends toward federal listing, and to provide a process and standard to ensure that these species receive full consideration in the decision-making process. The Regional Forester's sensitive species are shown previously in Table 3-201.

Applicable Forest-wide TES Standards from the Forest Plan:

FW-34 Maintain records of locations and conditions of Federally listed threatened and endangered species, and of Regional Forester's Sensitive species within the planning area.

FW-35 Control non-native invasive species where they are causing negative effects to threatened, endangered, or sensitive species. Do not intentionally introduce non-native species that are known or suspected of causing negative effects to federally listed threatened and engendered species in or near sites supporting these species.

FW-37 Delineate and maintain 1500-foot protection zones around all bald eagle nest and communal roost sites until they are determined no longer suitable. Management activities that modify the forest canopy within this zone are designed to be compatible with recovery of this species.

FW-41 Known occurrences of Virginia spirea, small-whorled pogonia, northeastern bulrush, and Virginia round-leaf birch are allocated to Management Prescriptions 4D and 9F to ensure protection and maintenance of their current populations and surrounding habitat conditions.

FW-44 Maintain a ¼ mile buffer of undisturbed forest around gray bat maternity and hibernation colony sites and Virginia big-eared bat maternity, bachelor, or winter colony sites. Prohibited activities within this buffer include cutting of overstory vegetation, construction of roads, trails, or wildlife openings, and prescribed burning. Exceptions may be made when compatible with recovery of these species.

FW-45 Each Indiana bat hibernaculum has a primary and secondary cave protection area managed according to management prescription 8E4. If additional hibernacula are found, the desired condition and standards of management prescription 8E4 apply until an environmental analysis to consider amendment to the Forest Plan is completed.

FW-46 In order to promote potential summer roost trees and maternity sites for the Indiana bat throughout the Forest, planned silvicultural practices in hardwood-dominated forest types will leave all shagbark hickory trees greater than 6 inches diameter breast height (d.b.h.) and larger, except when they pose a safety hazard. In addition: Clearcut openings 10 to 25 acres in size, will also retain a minimum average of 6 snags or cavity trees 9 inches d.b.h. or larger scattered or clumped. Group selection openings and clearcuts less than 10 acres in size have no provision for retention of a minimum number of snags, cavity trees, or residual basal area due the small opening size and safety concerns. All other harvesting methods (and clearcut openings 26-40 acres) will retain, in addition to the minimum 6 snags and cavity trees, a minimum residual 15 square feet of basal area per acre scattered or clumped. Residual trees are greater than 6 inches d.b.h. with priority given to the largest available trees, which exhibit characteristics favored by Indiana bats.

FW-48 When active roost trees are identified on the Forest, they will be protected with a ¼ mile buffer surrounding them. This protective buffer remains until such time they no longer serve as a roost (e.g., loss of exfoliating bark or cavities, blown down, or decay).

FW-49 No disturbance that will result in the potential taking of an Indiana bat will occur within this active roost tree buffer. Commercial timber harvesting, road construction, and use of the insecticide diflubenzuron are prohibited. Prescribed burning, timber cutting, road maintenance, and integrated pest management using biological or species-specific controls during non-roosting season are allowed following project level analysis to determine the direct, indirect, and cumulative effects on Indiana bats and the hibernacula. Other activities within this buffer are allowed following determination that they will not result in a potential taking of an Indiana bat.

FW-50 Removal of known Indiana bat active roost trees will be avoided, except as specified below.

FW-51 If during project implementation, active roost trees are identified, all project activity will cease within a ¼ mile buffer around the roost tree until consultation with

U.S. Fish and Wildlife Service is completed to determine whether project activities can resume.

FW-52 In the event that it becomes absolutely necessary to remove a known Indiana bat active roost tree, such a removal will be conducted during the time period when the bats are likely to be in hibernation (November 15 through March 31), through informal consultation with the U.S. Fish and Wildlife Service. Trees identified as immediate threats to public safety may be removed when bats are not hibernating, however, informal consultation with U.S. Fish and Wildlife Service is still required. Examples of immediate threats to public safety include trees leaning over a trail, public road or powerline that could fall at any time due to decay or damage.

FW-55 If active maternity roost sites are identified on the Forest, they will be protected with a 2-mile buffer defined by the maternity roost, alternate roost sites, and adjacent foraging areas.

FW-56 No disturbance that will result in the potential taking of an Indiana bat will occur within this active maternity roost site buffer. Commercial timber harvesting, road construction, and use of all pesticides are prohibited. All other activities within this buffer will be evaluated during project level analysis to determine the direct, indirect, and cumulative effects on Indiana bats, through informal consultation with the U.S. Fish and Wildlife Service.

FW-57 If during project implementation, active maternity roost sites are identified, all project activity will cease within a 2-mile buffer around the maternity roost until consultation with U.S. Fish and Wildlife Service is completed to determine whether project activities can resume.

FW-58 Monitoring of timber sales and other activities will be implemented as follows: Timber sale administrators or biologists will conduct and report normal inspections of all timber sales to ensure that measures to protect the Indiana bat have been implemented. Timber sale administrators will conduct normal inspections of all timber sales to administer provisions for protecting residual trees not designated for cutting under provisions of the timber sale contract. Unnecessary damage to residual trees will be documented in sale inspection reports and proper contractual or legal remedies will be taken. The Forest will include this information in their annual monitoring reports and made available to the U.S. Fish and Wildlife Service, if requested. Informal consultations among the U.S. Fish and Wildlife Service and the Forest will occur as needed in order to review and determine any need to modify provisions of the biological opinion, and other issues regarding the Indiana bat.

Direct, Indirect, and Cumulative Effects

Exploration and production activity would have minimal, if any, effects to any TES species that may occur in the area. Most effects would be associated with exploration and development activities that disturb or destroy habitat that supports the occurrence of a TES species. All activities that involve leases will require the preparation of a Biological Assessment and/or Biological Evaluation that determines effects on the TES species and outlines appropriate mitigation measures. TES species, no matter where they occur within the lease area, will be protected to ensure viable populations and suitable associated habitat. Controlled surface use and timing stipulations along with application of forest-wide and specific standards will reduce or eliminate most adverse impacts. Generally, specific locations of exploration and production activity is flexible, so impacts to TES species can be avoided by relocating the development and confining disturbance to previously disturbed areas. Federally listed species will require compliance with the

Endangered Species Act with species protection and recovery objectives outlined in the Recovery Plan prepared for each species. For state listed species, the Forest will cooperate fully with the protection and recovery objectives set forth by the state.

All alternatives include the general goal of contributing towards the recovery of federally-listed threatened and endangered species (T&E). Additionally, the following activities are common across all alternatives:

- Recovery plans (when available) will be followed for all T&E species;
- Forest-wide population objectives for threatened, endangered, and candidate plants will be followed;
- Forest-wide standards will be followed. For example, "sites supporting federally-listed threatened and endangered species or individuals needed to maintain viability are protected from detrimental effects caused by management actions";
- Threatened, endangered, and sensitive species will be conserved through the site-specific biological evaluation process;
- Surveys for all TES and their habitats will continue to be conducted on the Forest, particularly as part of the biological evaluation process in conjunction with projects likely to affect habitat for the species (project-level surveys would be conducted in accordance with procedures outlined in the Region 8 supplement of Forest Service Manual 2672);
- Monitoring of known populations of threatened, endangered, and sensitive species will be conducted consistent with Forest Manual direction.

WILDLIFE

The Reasonably Foreseeable Development (RFD) for federal oil and gas on the Jefferson National Forest is concentrated on the Clinch Ranger District. The Clinch District includes parts of five fifth code HUC watersheds, which have potential for future oil and gas development. These are: 0507020203, 0507020205, 0601020504, 0601020505, and 0601020601. Other watersheds that have a minor possibility of reasonably foreseeable development are 0208020103, 0208020108, 0505000108, 0505000110, 0505000202, 0505000203, 0601010101, and 0601010202. The Clinch Ranger District contains a variety of habitat types and corresponding associated wildlife species.

Direct, Indirect, and Cumulative Effects

The physical effects of oil and gas leasing upon wildlife include elimination of individuals which cannot move out of existing habitats being impacted by construction or reconstruction of access roads, clearing and leveling of drill pad sites, and construction of pipelines. Site access is developed by building a new road or improving an existing one. Table 3-195 depicts impacts from construction activities to soil productivity. These acreage figures are a good index to relative impacts by Forest Plan alternative. It is apparent that all the alternatives are very similar in their impacts.

Road and drilling pad construction result in the creation of edge and a reduction of forest interior habitat. Creation of edge can result in an increase in cowbird parasitism and predation upon a variety of species. However, given the entire Clinch District is within a heavily (>70%) forested landscape, the expected negative impacts of edge are not considered significant. Forest interior habitat will be lost as a result of road construction and creation of drilling pads. This loss is considered to be similar for each alternative, thus habitat for the ovenbird, a forest interior management indicator species, will be reduced for all alternatives.

Conversely, creation of edge and early seral habitat can benefit some species, such as white-tail deer and wild turkey. Early successional bird species, such as indigo buntings, eastern towhees, and field sparrows may benefit from the resulting open and brushy habitats created from RFD of oil and gas resources. Habitat for the eastern towhee, an early successional habitat management indicator species, will be improved under all alternatives. In addition, habitat for white-tailed deer and wild turkey will be improved.

Another means of assessing impacts, over the long-term, would be the acreage of National Forest considered unavailable or not allowing surface occupancy. Under Alternatives E, G, and I roadless areas do not allow surface occupancy and under all alternatives (except Alternative F), semi-primitive motorized and semi-primitive non-motorized areas do not allow surface occupancy. Thus, these alternatives promote the greatest potential of forest interior habitat over the long-term.

On the rest of the Jefferson National Forest in the next fifteen-year period, there could be an additional 16 well sites developed with an associated eight miles of road. This development would be spread out over eight different 5th Order (large) watersheds. Specific impacts would be the same for this as that discussed for the Clinch RD.

RECREATION

The Reasonably Foreseeable Development (RFD) for federal oil and gas on the Jefferson National Forest is concentrated on the Clinch Ranger District. The remainder of the forest is included in the RFD area but contains no current leases and has low potential for mineral development.

With the exception of the North Fork of the Pound and Cave Springs areas, discussed in the Roadless Area section below, all the RFD area on the Clinch Ranger District is in the Roaded Natural (RN) Recreation Opportunity (ROS) Class under all the alternatives. On the remainder of the forest, the reasonably foreseeable development scenario is limited to one exploratory well per decade for each of eight 5th level HUC watersheds. The RN setting allows human-made structures such as wellheads but these are generally scattered and remain visually subordinate from sensitive travelways. In the RN setting, remoteness is of little relevance due to the expected proximity to roads and/or facilities.

There are portions of 16 national forest system trails, totaling about 50 miles, within the RFD area on the Clinch Ranger District. These trails are multi-use, most allowing hiking, horseback riding and mountain biking. Hunting and some fishing are common dispersed recreation activities within the area as well. There are ten developed recreation sites within the RFD area on the Clinch Ranger District.

Direct and Indirect Effects

Oil and natural gas development would affect recreation activities primarily in terms of the degree to which the settings and patterns of use are changed due to development operations. Access road construction, gas well pad construction, gas pipeline construction and drilling operations could impact the recreation experience and settings.

A forest-wide standard common across all alternatives, with the exception of Alternative F the No Action Alternative, states “the Regional Forester consents to lease with a No Surface Occupancy stipulation semi-primitive non-motorized and semi-primitive motorized areas which have not been specifically noted as Congressionally withdrawn or administratively unavailable.” This standard includes semi-primitive 2 areas in Alternatives E, G, and I. Therefore effects from access road construction, gas well pad construction, gas pipeline construction and drilling operations are limited to Roaded Natural recreation opportunity spectrum settings in all alternatives with the exception of Alternative F. Under

Alternative F, within the watersheds outside of the Clinch Ranger District: 0208020103, 0208020108, 0505000108, 0505000110, 0505000202, 0505000203, 0601010101, and 0601010202; the reasonably foreseeable development scenario of one well per watershed per decade is so low, there is a very low probability of any affect on semi-primitive recreation.

The sights and/or sounds of gas development activities may negatively impact the experience of recreationists using trails or recreating off-trail in the vicinity of lease activity, particularly during the drilling operation, pipeline construction and subsequent maintenance periods. A short-term result would be use pattern changes in the form of avoidance and displacement to other areas. A normal drilling operation would require about three months, beginning with site clearing and ending with site restoration. With production operations, the disturbance would normally be limited to the immediate area of the wellhead and the access road. Given the latitude for well pad location contained in existing regulations, the negative impacts on the setting can usually be mitigated during the production phase to maintain consistency with the RN setting criteria. Long-term, site restoration would allow the RN criteria to be met. Direct impact to trails would occur in instances where access roads or pipelines cross them though these effects may be mitigated through rehabilitation, naturalization or trail relocation. Lease stipulations or Conditions of Approval on Surface Use Plans of Operations would ameliorate or eliminate impacts in some cases.

Based upon anticipated minerals activities and the resultant impacts on the Clinch Ranger District from expected new gas well sites, associated roads, pipeline clearing and disturbance, following is the ranking of the alternatives descending from greatest to least impacts: Alternative F, which has 144 new wells and 680 disturbed acres; Alternative B, having 121 new wells and 571 acres disturbed; Alternative G, having 119 new wells and 560 disturbed acres; Alternative E, having 115 wells and 542 disturbed acres; Alternative D, having 112 wells and 530 acres disturbed; and Alternatives A and I, which project 111 wells and 523 acres disturbed by the end of the second decade.

All of the ten developed recreation sites would be protected from direct affects of gas production by the Controlled Surface Use stipulations or Conditions of Approval on Surface Use Plans of Operations under all of the alternatives. However, there is some potential for recreationists to hear or see evidence of gas development activities taking place near the recreation site. These would normally be short- term impacts during production periods.

There is no anticipated gas well development in the next two decades on the Glenwood Ranger District and the Mount Rogers National Recreation Area. The potential impacts from new gas well development on the New Castle and New River Valley Ranger Districts would be from a total of approximately 16 new wells and an associated 72 acres of disturbance over the next 15 years. This level of activity is the same for all alternatives. Effects on recreation settings, and experiences would be similar to those described above but would be more isolated and limited to construction and drilling phases. Consistency with ROS classification would be maintained through mitigation and site restoration. Leases in areas classified as Semi-primitive Non-motorized (SPNM) or Semi-primitive Motorized (SPM) would include No Surface Occupancy (NSO) stipulations.

Cumulative Effects

Existing federal leasing includes 14 oil and gas leases on 14,979 acres mostly in the Pine Mountain area and a request for federal leases on 5,191 acres on the Clinch Ranger District west of Keokee Lake in Lee County. There are no other current or pending federal leases on the forest other than on the Clinch Ranger District.

SOCIAL AND ECONOMIC DEVELOPMENT

MINERAL RESOURCES

FEDERAL OIL AND GAS REASONABLY FORESEEABLE DEVELOPMENT SCENARIO (RFD)

Considering both potential federal leases and potential private gas wells on national forest land, and the resultant impacts on the Clinch Ranger District from expected new gas well sites, associated roads, pipeline clearing and disturbance, following is the ranking of the alternatives descending from greatest to least impacts: Alternative F, which has 324 new wells and 1,530 disturbed acres; Alternative B, having 284 new wells and 1,335 acres disturbed; Alternative D, having 275 new wells and 1,300 disturbed acres; and G, I, E and A, each of which project 263 wells and 1,236 acres disturbed by the end of the second decade.

The potential impacts from new gas well development on the New Castle and New River Valley Ranger Districts would be from a total of approximately 16 new wells and an associated 72 acres of disturbance over the next 15 years. This level of activity is the same for all alternatives.

Forest-wide, consistency with ROS classifications would be maintained with appropriate lease stipulations, controls and mitigation measures under all the alternatives. On the Clinch Ranger District, some general displacement of recreation use can be expected especially during periods when development is active and/or concentrated. Cumulative physical impacts to the trails system would be mitigated through rehabilitation, naturalization or trail relocation.

ROADLESS AREAS

The RFD area on the Clinch Ranger District includes the North Fork of the Pound Roadless Area and the Cave Springs Area that is considered for potential wilderness recommendation.

Virtually all of the North Fork of the Pound Roadless Area is either under existing federal lease for gas production or has privately owned mineral rights.

Within the watersheds outside of the Clinch Ranger District: 0208020103, 0208020108, 0505000108, 0505000110, 0505000202, 0505000203, 0601010101, and 0601010202; the reasonably foreseeable development scenario consists of one well per watershed per decade.

Direct, Indirect, and Cumulative Effects

The North Fork of the Pound Roadless Area would have the NSO stipulation for new leases under Alternatives A, G, and I. Approximately 4,271 acres or 90% of this area is classified as SPNM and would have NSO stipulations under Alternatives A, B, D. The remainder of the area would have Standard or Controlled Surface Use stipulations. However, due to existing valid production leases and potential private gas production, this area has a potential for well pad construction, road construction, pipeline construction and drilling operations during the next 20-30 years that would affect the areas roadless characteristics for the foreseeable future. Recreationists using this area will be aware of the sights and sounds of industrial activity and vehicle traffic on roads and this would reduce the area's ability to provide a remote experience or solitude. Some users will be displaced to other areas especially during heavy development periods.

Under Alternatives E, G, and I the Cave Springs area would be available for lease under the NSO stipulation that would protect that area from direct affects of the development. Recreationists using the area would not be aware of off-site drilling activity and this would be consistent with the area's ROS class. Approximately 2,500 acres or 76% of this area is classified as SPNM and would have NSO stipulations under Alternatives A, B, D. The remainder of the area would have Standard or Controlled Surface Use stipulations. Thus, there would be somewhat more direct physical effect on the area from development as well as on the recreation setting and experience under these alternatives.

Roadless areas across the remainder of the Forest would have a No Surface Occupancy stipulation under Alternatives E, G, and I. The semi-primitive cores of these areas would have a No Surface Occupancy Stipulation under Alternatives A, B, and D. Under all alternatives the reasonably foreseeable development scenario for watersheds outside of the Clinch Ranger District is quite low and there is a very low probability of effects on the roadless character of any other inventoried roadless areas.

ELIGIBLE WILD AND SCENIC RIVERS

The RFD area on the Clinch Ranger District includes five streams found eligible for Wild and Scenic designation (see Chapter 3, Wild and Scenic Rivers section and Appendix D for more detailed information). Little Stony Creek, and portions of the Clinch River, Guest River and Russell Fork have preliminary classifications of recreational while Roaring Branch has a preliminary classification of wild. Except for Russell Fork, the mineral rights within these stream corridors are virtually all privately owned.

Within the watersheds outside of the Clinch Ranger District: 0208020103, 0208020108, 0505000108, 0505000110, 0505000202, 0505000203, 0601010101, and 0601010202; the reasonably foreseeable development scenario consists of one well per watershed per decade. None of these watersheds contain eligible for Wild and Scenic River designation.

Direct, Indirect, and Cumulative Effects

Within stream corridors eligible under the recreational classification any federal leasing would have Controlled Surface Use stipulations under all alternatives. This would pertain to Russell Fork in which the mineral rights are federally owned. Should leasing occur, there would be some effects as described in the various sections (e.g., Recreation, Scenery, Aquatic Species) of this EIS. However, the outstandingly remarkable values identified for this stream would be protected under lease stipulations or Conditions of Approval on Surface Use Plans of Operations.

SCENERY

The scenic resource is affected by management activities altering the appearance of what is seen in the landscape. Short-term scenic effects are usually considered in terms of degree of visual contrast with existing or adjacent conditions that result from management activity. The scenic landscape can be changed over the long-term or cumulatively by the alteration of the visual character. Management activities, which result in visual alterations inconsistent with the assigned SIO, even with mitigation, affect scenery. Management activities that have the greatest potential of affecting scenery are road construction, vegetation management, insect and disease control, special use utility rights-of-ways, and mineral extraction.

Mineral management and development activities can involve major alternation to landform, as well as contrasts to form, line, color, and texture, causing substantially adverse scenic impacts. Natural gas drilling and production are common on the Clinch Ranger District. The other ranger districts have very limited activity usually involving shale pits, limestone extraction and surface building rock collection.

The most significant visual impacts from natural gas well development would occur during the drilling operation and subsequent maintenance periods. Drilling rigs and other equipment would give the area an industrial look that is out of character with the surrounding landscape. The negative visual impacts from drilling would include the construction of well pads and access roads along with the operation and sight of the necessary drilling equipment. A normal drilling operation would require about three months, beginning with site clearing and ending with site restoration. The areas are moderate to steeply sloped and there may be some steep cut slopes that would likely be necessary in the construction of roads.

With production operations, there would be minimal disturbance, limited to the immediate area of the wellhead and the access road. Given the latitude for well pad location contained in existing regulations, the negative visual impacts can usually be mitigated during the production phase to meet the assigned scenic integrity objective.

There is no anticipated gas well development in the next two decades on the Glenwood Ranger District and the Mount Rogers National Recreation Area. The potential impacts from gas well development on the New Castle and New River Valley Ranger Districts is a total of 16 new wells over the next 20-year period. This projection is the same for all alternatives.

The majority of gas well drilling and development in the next two decades will take place on the Clinch Ranger District. Based upon anticipated minerals activities and the resultant impacts from expected new gas well sites, associated roads, pipeline clearing and disturbance to soils, the ranking descending from the greatest impacts to least impacts on the Clinch Ranger District is: Alternatives F, which has 324 new wells over 20 yrs and 1,530 disturbed acres; B has 284 new wells and 1,335 acres disturbed and D 276 new wells and 1,300 disturbed acres; G, I, E and A drop to 268 wells then down to 263 new wells over 20 yrs and 1,257 acres down to 1,236 disturbed acres.

The Pound Reservoir, Powell River, and Stock/Cove/North Fork Clinch River drainage areas do not currently exhibit gas well surface occupancy on federal lands. Impacts will be a new intrusion on the natural appearing landscapes in these areas but it is anticipated that the activity, even though evident, can be designed to mitigate most negative effects and meet assigned scenic integrity objectives. The Russell Fork and Stock/Guest/Clinch River drainages currently are impacted by gas well development. Additional wells will be added in these areas resulting in some cumulative impacts. It is anticipated that through good design and application of mitigation measures, the scenic integrity objectives will continue to be met in these areas as well.

Other Effects

This analysis only considers the availability of and consent to lease. The act of leasing alone does not cause impacts. Further environmental analysis must be completed before post-leasing activities are authorized. This analysis would be more site-specific and oriented towards actual operating plans. Additional mitigation measures and stipulations designed to mitigate adverse environmental impacts would be considered.

Actual extraction of oil and gas would be considered an irreversible commitment, since this is a non-renewable resource. However, the decision to actually permit this extraction will occur following receipt of an Application for Permit to Drill, therefore the consent to lease decision is not an irreversible commitment. On the other hand, a decision not to consent to issue a Federal oil and gas lease in a particular area is an irretrievable commitment because the production opportunities are foregone for this planning period.

Alternative G has the largest acreage congressionally withdrawn and administratively unavailable at 211,000 acres (29% of the Forest). Alternative F has the least acreage withdrawn (or unavailable) at 55, 700 acres, which includes only Federal subsurface ownership within the current 11 congressionally designated wilderness areas. Other alternatives in order of most acreage withdrawn or unavailable are Alternatives E, I, A, B, D. See Table 3-187.

Based on the reasonably foreseeable development scenario for each alternative, potential irreversible or irretrievable losses related to other renewable and non-renewable resources are limited to small areas. The magnitude of these losses is consequently limited to the same extent. See Table 3-188. Regardless of the alternative selected, oil and gas activities will be constrained to comply with all laws, including the Endangered Species Act.

RANGELANDS

These lands include approximately 8,200 acres of improved pastures and mountaintop balds primarily on the Mount Rogers National Recreation Area (NRA), although small amounts also occur on the Glenwood, New Castle and New River Valley Districts as shown in Table 3-202. Livestock grazing of cattle, horses and ponies is used to help maintain these lands in an open grassland or grass/forb/shrub stage and to preserve the open,

Table 3-202. Total fenced grazing land acreage, acres with a range objective and the relative percentage of occurrence by District on the Jefferson National Forest 2002

Ranger District	Total Fenced NF Acres By District	NF Acres with a Range Objective	Percent of Acres With Range Objective Per District
Blacksburg	166	134	3%
Glenwood	90	90	2%
NRA	7,653	4,294	90%
New Castle	120	87	2%
Wythe	185	163	3%
Total	8,214	4,768	100%

pastoral setting on selected portions of the Forest such as the Mount Rogers NRA. Specifically, these areas are not only managed to provide forage for livestock and aid the local economy, but also to provide a variety of recreational opportunities such as maintaining scenic views, picnicking, wildlife viewing, cross country skiing, and hiking. These early successional habitats along with their intermingled, isolated patches of woodlands also provide valuable habitat for a variety of wildlife species including deer, turkey, rabbits, voles, raptors, and a variety of migratory songbirds. Such areas receive some of the highest levels of recreation visitor use on the Forest, especially along Scenic Byways, the Appalachian Trail corridor, and areas of major wildlife interests. Livestock grazing is used as a primary vegetation management tool on the balds area within the Mount Rogers Crest Zone and at Elk Garden. These areas are considered in more detail in the rare community section of this plan.

Livestock grazing has a long history in this area. It is likely the earliest settlers capitalized on the open grassland conditions of the Great Valley and other significant open areas that were maintained for centuries by Native Americans and animals such as bison and elk. Many early accounts of the area, including that of Elisha Mitchell in 1838, and Asa Gray in 1841, make note of the existing livestock grazing. Many of the natural plants inhabiting such areas were either reduced to remnant stands through overgrazing or converted to

SOCIAL AND ECONOMIC DEVELOPMENT

RANGELANDS

domestic vegetation brought from Europe by the settlers. Heavy seasonal grazing from cattle, sheep, goats and horses was largely responsible for maintaining mountaintop bald areas such as at Mount Rogers, Elk Garden, and Chestnut Mountain.

Livestock grazing is managed through a site-specific Allotment Management Plan and Environmental Assessment supported by a thorough analysis of the range situation as directed by the 2200 section of the Forest Service Manual and pertinent handbooks. All grazing use is by permit only and yearlong permits are discouraged. Term Grazing Permits are preferred over other permit types because of their stronger controls, management flexibility, and Fee Credit availability.

Grazing of livestock on National Forest requires the development of a variety of range improvements and livestock control measures. These include structures such as fences, water developments, corrals, gates and cattleguards. Most of these improvements are typically constructed by the Forest Service and maintained annually to Forest Service standards by the grazing permittee. Many of the structures, especially fences on the Mount Rogers NRA, have exceeded their useful lifespan and are in dire need of reconstruction. Some fences have been reconstructed through the Fee Credit program that allows funds collected from the grazing permit to be used on that allotment for improvement of the rangeland condition. Such projects are usually implemented by the grazing permittee under the direction of the Forest Service through a Fee Credit Agreement. In most cases, funding from all available sources is insufficient to meet the needs of this program on all these lands.

Forage production appears good on most allotments and livestock numbers are adjusted as necessary to meet the carrying capacity and provide for wildlife needs. Infestations of May beetle larvae have occurred on three occasions on the Mount Rogers NRA. The first infestation occurred in the late 1980’s and caused significant damage to almost 400 acres of rangeland in two allotments. The later infestations occurred in 2001 and 2002 and affected less than 100 acres in one allotment. Areas affected by May beetles require complete revegetation.

Although pastureland acreage has been significantly reduced over the last 50 years, pastures still comprise approximately 7 percent of the Southeastern United States (USDA Forest Service 2001). For Southern Appalachian Assessment Area, pastures comprise approximately 17 percent of the area, 99 percent of which is on private land (SAMAB 1996).

Direct and Indirect Effects

All grazing is eliminated under Alternative G and approximately half of the acreage and subsequent grazing capacity is eliminated under Alternative B (Table 3-203). Under these alternatives these lands would soon revert to hardwood forest types resulting in the loss of a valuable element of diversity that benefits many resource areas. Under Alternative A, all grazing lands are stocked to their maximum capacity showing an approximately 20% increase over the current grazing level. This alternative, while maximizing grazing benefits, may adversely affect other resource areas such as wildlife, soils and water. The remaining alternatives are similar to the current grazing acreages and levels of use. The grazing capacity for Alternative I could be increased slightly (approximately 10%) on selected allotments through improved soil fertility and increased stocking on the Crest Zone Allotment. However, permittees are reluctant to increase livestock numbers in the Crest Zone because of the risks of livestock loss. Increasing livestock numbers on these areas could increase trampling impacts on some sections of the grazing allotment, especially around livestock watering areas. Any increases in grazing capacity must be supported by data that documents a sustained increase in forage production over a reasonable time.

Table 3-203. Total grazing land acreage of pastures and balds and grazing capacity (animal unit months, AUM's) for each alternative on the Jefferson National Forest 2002.

Alternative	Total Fenced NF Acres By District	NF Acres with a Range Objective	Grazing Capacity Animal Unit Months (AUM's)
A	8,214	4,768	11,195
B	4,107	2,384	4,664
D	8,214	4,768	9,329
E	8,214	4,768	9,329
F	8,214	4,768	9,329
G	0	0	0
I	8,214	4,768	10,262

Cumulative Effects

There appears to be an abundance of improved pastures on nearby private lands. However, pasture and cropland have decreased by about 300,000 acres since 1982 in the Blue Ridge and the Southern Mountain and Piedmont Sections (SAMAB 1996a). In contrast, developed acreage has increased by more than 600,000 acres. Land use has also changed over much of this area from grazing to Christmas tree farming. These trends are expected to continue well into the future as demand for housing developments, summer cabins, golf courses and tree farms continue. This may explain the rising demand for additional grazing lands on the Jefferson National Forest as shown by the number of respondents and high bid prices received on advertisements for such grazing opportunities, especially within the Mount Rogers NRA.

ROADS SYSTEM MANAGEMENT

System roads of the Jefferson National Forest currently total 1,215 miles (including decommissioned roads) and serve a variety of resource management and access needs. Over the past several years, the system has been fairly stable with regards to total mileage, Objective Maintenance Level (OML) breakdown, and type of resource management support. Projected road construction mileage for recreation and related needs over the plan period is relatively small ranging from 1 mile for Alternative G to a high of 10 miles for Alternatives A and I. The reasonable foreseeable development scenario for minerals-related road construction is largely independent of Alternative, and ranges from a low of 43 miles over the plan period to a high of 55 miles. Most of these mineral-related roads would be located on the Clinch Ranger District. In general, these

Table 3-204. Miles of Estimated Road Construction by Alternative

Primary Purpose	Alternative						
	A	B	D	E	F	G	I
Timber	44	39	84	9	46	6	34
Federal Minerals (Reasonably Fore-seeable Development Scenario)	43	47	43	45	55	45	44
Recreation and Other	10	5	5	5	5	1	5-10
Decommissioning	10	20-30	20	20	15-20	20-30	15-20

roads would have an anticipated use period of approximately 30 years, at which time most would be obliterated. Anticipated road construction for timber-related functions is highly dependant on Alternative and ranges from a low of 6 miles for Alternative G to a high of 84 miles for Alternative D. See Table 3-204 for a complete breakdown of potential road construction mileage by function and Alternative.

There is an aggressive effort currently ongoing with regards to management of the Forest road system. This effort is aimed at identification of opportunities for increased resource protection, eliminating the backlog of deferred maintenance, optimal performance of maintenance, and better service to Forest users. One initiative includes identification of roads that would be better and more efficiently maintained by the Virginia Department of Transportation (VDOT). These include current Forest roads that have a primary function of other than Forest access and use. Examples include roads that primarily function as commuter routes for work and school. Currently, 24 miles of Jefferson National Forest roads have been identified as possible candidates for VDOT maintenance. It is anticipated that at least a portion of the 24 miles of road will be upgraded and turned over to VDOT within the current Plan period.

Another initiative includes the extensive use of project level roads analysis for decisions regarding changes to the road system. These analyses will be conducted to provide managers with data to make informed decisions concerning road system changes, additions, and deletions. Analyses will be conducted in accordance with current Forest Service Guidelines. A completed analysis will inform future management decisions on the merits and risks of building new roads in previously unroaded areas; relocating, upgrading, or decommissioning existing roads; managing traffic; and enhancing, reducing, or discontinuing road maintenance (USDA Forest Service 1999).

Management of the Forest's roads will also include intensive on-the-ground field condition surveys followed by clear and concise reporting of the existing condition. This process will include condition surveys on one quarter of the Forest's Operational Maintenance Level (OML) 3, 4, and 5 roads each year. Level 1 and 2 roads will be inventoried on a random sample basis, with any immediate need noted and corrected as funding allows.

The existing 1,202 miles of system roads (does not include the 13 miles of decommissioned roads in the inventory) on the Jefferson National Forest include some mileage in each of the 5 Objective Maintenance Level Classes. There is currently only one mile of OML-5 (High degree of user comfort and convenience) road on the Jefferson. This is a recent addition. The existing inventory includes 1 mile of OML-5 road, 31 miles of OML-4 road (Moderate degree of user comfort and convenience at moderate travel speeds), 367 miles of OML-3 road (Suitable for passenger cars), 707 miles of OML-2 road (High clearance vehicles), and 96 miles of OML-1 road (Basic custodial care).

Direct and Indirect Effects

As Table 3-204 indicates, the largest potential increases in road mileage over the Plan period are in the areas of Minerals and Timber. In comparison, the potential contributions to road system mileage for Recreation and related activities is relatively small and would, under all the Alternatives, be offset by the planned rate of decommissioning. Table 3-204 provides a summary of the estimated miles of road construction by Purpose and Alternative. This Table indicates that the potential net mileage increases range from a low of 39 miles for Alternative E to a potential high of 112 miles for Alternative D over the plan period. The estimated increase in road mileage for Alternative I is 63 to 73 miles over the plan period.

Under Alternative A, new road construction and reconstruction would be prohibited on

Table 3-205. Acres of Jefferson National Forest subject to various road standards under each alternative

	Alternative						
	A	B	D	E	F	G	I
	(Thousands of Acres)						
Construction and Reconstruction Prohibited	154.6	157.2	101.5	225.5	128.7	245.8	209.2
Construction Prohibited. Limited Reconstruction.	14.7	14.1	17.9	17.2	77.4	18.7	22.4
Limited Construction and Recon-struction	172.6	172.3	106.1	237.3	71.6	180.7	126.8
Construction and Reconstruction Allowed. No increase in Open Road Density.	155.4	203.7	73.1	79.0	157.0	203.0	206.9
Construction and Reconstruction Allowed.	226.0	176.0	424.7	164.3	288.6	75.1	158.0

Limitations and prohibitions are subject to valid existing rights and leases.

154,600 acres of Forest land (see Table 3-205). This Alternative would prohibit new construction and allow limited reconstruction on an additional 14.700 acres and allow limited construction and reconstruction on 172,600 acres. Construction and reconstruction would be allowed on 155,400 acres of land, with no increase in open road density. This Alternative would allow new construction and reconstruction on the remaining 226,000 acres of land. Under this Alternative, road construction for Timber and Minerals is estimated to be nearly equal (44 and 43 miles, respectively), with the mileage of road construction for Recreation and related uses offset by the decommissioning rate. The potential net gain of road mileage under this alternative is a maximum of 87 miles over the plan period. The vast majority of these roads would have a limited span of use, and would be obliterated following that use.

Under Alternative B, road construction/reconstruction would generally be more prohibitive than reflected in Alternative A, with road construction and reconstruction prohibited on 157,200 acres of land. Under this Alternative, construction would be prohibited and limited reconstruction allowed on an additional 14,100 acres of land. Limited construction and reconstruction would be allowed on 172,300 acres. For this Alternative, construction and reconstruction would be allowed on an additional 203,700 acres, provided there was no increase in open road density. Alternative B would allow construction and reconstruction on the remaining 176,000 acres of land. Under Alternative B, it is estimated that new construction/reconstruction for Recreation and related uses would be minimal (less than 0.5 miles per year) and the rate of construction for this use would easily be offset by the rate of decommissioning. Under this Alternative, there is potential for construction of 47 miles of minerals-related roads and 39 miles of timber roads. While this Alternative does share the highest planned rate of decommissioning with Alternative G (20-30 miles over the plan period), the potential net increase in mileage is 61 to 71 miles.

Alternative D is generally the least restrictive for road construction. This Alternative would prohibit construction and reconstruction on 101,500 acres of Forest land; prohibit construction but allow reconstruction on 17,900 acres; allow limited construction and reconstruction on 106,100 acres; allow construction and reconstruction with no increase in open road density on 73,100 acres; and allow construction and reconstruction on the remaining 424,700 acres. Under this Alternative, new road construction/reconstruction for recreation, wildlife, and similar resource needs would be minimal (less than 0.5 miles per year), and would be offset by the decommissioning rate. This Alternative has potential for construction of up to 84 miles of timber-related roads and 43 miles of minerals-related roads; therefore, this Alternative could realize a net gain of approximately 112 miles of road over the plan period.

For Alternative E, road construction and reconstruction would be prohibited on 225,500 acres, the most restrictive of all the Alternatives. Under Alternative E, no permanent road construction would occur within the 153,100 acres of inventoried roadless areas. This Alternative would prohibit construction and allow limited reconstruction on 17,200 acres. Limited construction and reconstruction would be allowed on 237,300 acres with construction and reconstruction allowed (no increase in open road density) on 79,000 acres. On the remaining 164,300 acres, construction and reconstruction would be allowed. Due to the emphases for Alternative E, new construction/reconstruction of 0.5 mile per year is estimated for recreation and related activities. Potential construction for minerals is comparable to the other Alternatives with a reasonably foreseeable development of up to 45 miles of road. Under this Alternative, timber related road construction would be significantly limited, with less than 1 mile of construction per year (9 miles total over the plan period). Decommissioning of unneeded roads would be emphasized for this Alternative, with an estimated 2 miles per year decommissioned. Thus, the total mileage of decommissioned roads would offset the roads constructed for recreation and timber combined.

Alternative F reflects the emphases of the existing Jefferson National Forest Plan. This Alternative would prohibit construction and reconstruction on 128,700 acres; allow limited reconstruction with full construction prohibition on 77,400 acres; allow limited construction and reconstruction on 71,600 acres; allow construction and reconstruction with no increase in open road density on 157,000 acres; and allow construction and reconstruction on 288,600 acres. Under this Alternative, road construction for recreation and related activities would be approximately 0.5 miles per year with a decommissioning rate of approximately 1.5 to 2.0 miles per year. Road construction for timber-related purposes would be as much as 46 miles with a maximum of 55 miles of road construction for minerals-related activities. Net gain in road mileage for this Alternative would be approximately 86 to 91 miles over the plan period. The majority of these roads would have a limited time span of use.

Alternative G would prohibit construction and reconstruction of roads on 245,800 acres and allow limited reconstruction with no allowable construction on 18,700 acres. Under Alternative G, no permanent road construction would occur within the 153,100 acres of inventoried roadless areas. Alternative G would allow limited construction and reconstruction on 180,700 acres of land. Construction and reconstruction would be allowed under this Alternative on 203,000 acres provided there was no increase in open road density. Construction and reconstruction would be allowed on only 75,100 acres of land under this Alternative. Due to the various emphases of this Alternative, road construction for other than mineral extraction would be minimal. Timber related road construction would average just over 0.5 mile per year (6 miles over the plan period) and road construction for recreation and related activities would be almost negligible (approximately 1 mile over the 10 year plan period). Road construction for mineral-related activity for this Alternative would not be expected to exceed 45 miles. This Alternative would result in a net gain of approximately 22-32 miles of road over the plan period.

Under the provisions and restrictions of Alternative I, road construction and reconstruction would be prohibited on 212,100 acres of Jefferson National Forest land with construction prohibited and reconstruction limited on an additional 20,300 acres. Under Alternative I, no permanent road construction would occur within the 153,100 acres of inventoried roadless areas. Alternative I would allow limited construction and reconstruction on 124,600 acres and would allow construction and reconstruction on an additional 226,200 acres with no increase in open road density allowed under the latter provision. Construction and reconstruction would be allowed on the remaining 140,100 acres of land. For this Alternative and its emphases, new construction/reconstruction for recreation and related activities is estimated to be 0.5 to 1 mile per year with an estimated decommissioning rate of 1.5 to 2 miles per year. Thus, the rate of new road construction/reconstruction for recreation-related activities would be offset by the decommissioning rate. For this Alternative, it is anticipated that timber-related activities will require the construction of approximately 34 miles of new roads, and mineral-related activities will require construction of approximately 44 miles of road. This would result in a net increase of Forest roads under this Alternative for all road construction activities of 63 to 73 miles over the plan period. Again, the vast majority of these roads would have a limited time span of use, and most would be obliterated after that use.

LAND USE

The boundary of the Forest encompasses 1.67 million acres, however only 723,300 of those acres are National Forest system land, or land acquired by the National Park Service and administered by the Forest Service. National forest land is interspersed with land that remains in private ownership.

As of November 2002, the Forest property boundaries totaled nearly 2,540 miles. In an ongoing effort, 71% of these boundaries have been marked and can be readily identified by the general public. Generally, forest ownership consists of mountains and ridge tops, with the valleys remaining in private ownership. This results in an ownership pattern that is long and narrow and for that reason, there are few opportunities in a north/south direction to get from the west side of the forest to the east side without crossing national forest at some point.

The intermingled ownership pattern causes some Forest tracts to be inaccessible to the public and difficult to manage.

Direct, Indirect, and Cumulative Effects

All alternatives have similar land adjustment programs aimed at consolidating national forest ownership, however each alternative has a different emphasis or priority. Lands are to be added through either acquisition or exchange.

SPECIAL USES

As of November 1, 2002, approximately 14,023 acres of the Forest were under Special Use authorization to individuals, corporations, and other government agencies. The predominant uses are for public roads, communication facilities, and utility rights-of-way. Water uses are the next major use category and private road access is the fifth major use category.

Special use authorizations for personal use are a minor land commitment. Less than 150

SOCIAL AND ECONOMIC DEVELOPMENT

SPECIAL USES

acres are devoted to private uses (excluding communication sites and utilities) such as private road easements and permits, well/springs, cultivation, etc.

There are no authorizations for recreation residences on the Forest.

Recreation special uses such as those for outfitter/guides and competitive recreation events provide recreation opportunities to the public that the Forest does not provide. Although all alternatives restrict competitive recreation events, Alternative A is the most restrictive, limiting them on 53% of the forest; and Alternative F the least restrictive, limiting them on 32% of the forest.

Utility Corridors

Rights-of-way 50' and over in width located within designated utility corridors comprise 54% of the linear rights-of-way under authorization, and are primarily electric lines in excess of 138,000 KV and natural gas transmission lines.

Facilities in utility corridors are authorized by special use authorization. When compatible, new uses are accommodated by widening existing corridors rather than designating new corridors.

Direct, Indirect and Cumulative Effects

All alternatives designate areas as unsuitable for new utility corridors in certain areas (i.e. wilderness and special areas), with Alternatives E and G having the most area, approximately 40% of the Forest, designated an unsuitable. In addition to those areas where new corridors are unsuitable, all alternatives also discourage or somehow restrict development of new corridors in additional management prescriptions, with Alternative G having the most with restrictions on approximately 81% of the Forest; Alternative E, with restrictions on approximately 80% of the Forest; Alternative A, with restrictions on approximately 67% of the forest; Alternative B, with restrictions on approximately 61% of the Forest; Alternative I, with restrictions on approximately 61% of the Forest; Alternative D, with restrictions on approximately 45% of the Forest; and Alternative F, being the least restrictive with restrictions on approximately 42% of the Forest.

Although all alternatives have areas where new corridors are considered unsuitable and also restricted, there are opportunities under each alternative to cross national forest system lands with new utility corridors.

Communication Sites

CLINCH RANGER DISTRICT

Eagle Knob Communication Site was classified as a communications site on March 12, 1976 by the Regional Forester and is the most developed of all sites on the Forest. It is 33.5 acres in size and is located on USA Tract 1, Longitude 82°37'44", Latitude 36°53'22" and is in Wise County, Virginia. The elevation is 4,160 feet and access is via Forest Service Road 238. Power and telephone exist to the site. Low and high power uses are allowed, however high power uses must insure that they will not interfere with other uses. Commercial two-way radio systems, private mobile radio systems, cellular telephone site use, television broadcast systems, industrial microwave systems and a resource monitoring system are currently located at the site and occupy about 7.64 acres. The Forest also has a repeater/base station for internal communications located at the site. Through maximizing utilization of existing structures and development of the remaining site, the site will continue to accommodate future applicants. Demand by additional users is not anticipated to reach the carrying capacity of the site.

High Knob Communication Site has not previously been classified or designated as a communication site and is being designated through the Forest Plan Revision process. The site is located on USA Tract 1 approximately ½ mile south of the High Knob Observation Tower, Longitude 82°37'42", Latitude 36°53'10" and is in Wise County, Virginia. The site designation is 1 acre in size. Access is off of State Road 619 via Forest Service Road 237. A cable TV receiver has occupied the site since 1978 and a 145 foot guyed tower currently exists for that use. The use was originally located at the Eagle Knob Communications Site but because of interference and the inability to receive and send out a good quality picture, they moved to private land adjacent to the High Knob site. They continued to experience interference at the site on private land and applied to move the site to High Knob in 1978. An Environmental Analysis Report was completed and the decision was made on August 29, 1978 to allow the use at the High Knob location. The Forest has since added a repeater/base station for internal communications located at the site. There has been no interference at the site and it is well suited to become a designated communication site. The Eagle Knob Communications Site lays 1 ¾ miles northeast of the High Knob site. Suitable non-federal land does not exist due to topography and existing uses that cause interference. Compatible uses would be other low power uses that do not interfere with the existing uses. The existing tower does not require lighting by the FAA and towers 200'+ in height, or towers requiring lighting by the FAA will not be allowed. Use at the site has been documented since 1978 and a special use permit currently authorizes improvements at the site, therefore it only make sense at this point that the site be officially designated as a communication site. Demand for additional use of the site has been non-existent for the past 8 years and this is not anticipated to change. The small size of the site limits future use.

Mayking Peak Communication Site on Pine Mountain has not been previously been classified or designated as a communication site and is being designated through the Forest Plan Revision process. The site is located on USA Tract 916, Longitude 82°44'19", Latitude 37°06'38" and is located in Letcher County, Kentucky. The proposed site designation is 2 acres in size. Access is via Forest Service Road 2260 off of State Road 671. An FM radio transmitter has occupied this site since 1985, and prior to that Kentucky Educational Television (KET) occupied the site since 1978. KET no longer needed the site and sold the improvements to the FM radio station. In addition, records indicate that another radio station applied in 1969 for a special use permit to authorize occupancy of part of the site with guy wires from their tower, which was to be located on adjacent private land. A site plan was executed in 1969 that authorized that occupancy however it appears that the tower may have been constructed on the wrong side of the forest boundary, as a tower is located on NFS lands in that precise area. Both towers are 100 feet in height and neither requires lighting. The old radio tower is in poor shape and if it is determined that this tower is actually located on National Forest, removal would be required when it is no longer being used. Compatible uses would be other low or high power uses that do not interfere with the existing use. The existing towers do not require lighting by the FAA and towers 200+ feet in height, or towers requiring lighting by the FAA will not be allowed. There has been no history of interference from this site and because of the topography, with the highest elevation be located on National Forest, the best location for the towers is on National Forest. Use of this site has been documented since 1969 and special use permits currently authorize improvements at the site therefore it only make sense at this point that the site be officially designated as a communication site. Demand for additional use of the site has been non-existent for the past 8 years and this is not anticipated to change in the near future. The location of the site on the VA/KY border and the small size of the site limits future use.

GLENWOOD RANGER DISTRICT

Apple Orchard Communication Site was classified June 2, 1976 as a communication site by the Regional Forester. It was classified as a 35-acre site, however less than 2 acres are currently developed, therefore the site is being designated as a 2 acre site. The site is located on USA Tract 50, Longitude 79°, 31” 00”, Latitude 37°, 31’ 00” and is in Bedford and Botetourt Counties. The elevation is 4,000 feet and access is via Forest Service Road 35 from the Blue Ridge Parkway. Power and telephone exist to the site. Uses at this site are subject to the restrictions of the National Radio Quiet Zone. The majority of uses at this site are other federal and state agencies, however authorizations for amateur radio use, commercial two-way radio systems and a local telephone exchange network also exist. The Forest also has a repeater/base station for internal communications located at the site. Because of the large FAA Radome on the site, the site is highly visible from the Blue Ridge Parkway, although for only few seconds at a time over a short distance. The site is also visible from Interstate 81 due to the Radome. The site is not near fully developed in terms of its originally classified size, but future development is currently limited by the site plan to the existing developed size (1.85 acres) and current building space availability.

MOUNT ROGERS NATIONAL RECREATION AREA

Quebec Knob Communication Site has not been previously classified or designated as a communication site and is being designated through the Forest Plan Revision process. The site is located on USA Tract U-348 on Quebec Knob in the location of an old fire tower, Longitude 81°31’22”, Latitude 36°46’36” in Smyth County, Virginia. The proposed site designation is 5 acres in size. Access is via Forest Service Road 243 and 243a through Currin Valley from State Road 671. The elevation is 3,627 feet. Because of the topography in this area, the Mount Rogers NRA experiences “dead spots” in it communications system and the Smyth County 911 system is experiencing the same problems. Designating this as a site will eliminate the safety concerns that lack of contact with the field units for the Mount Rogers NRA has, as well as the ability for Smyth County Emergency Response to have communications from its responders in the field to the hospital and base station in areas where coverage is currently very poor or non-existent. After the site is designated, a site plan will be developed. Compatible uses would be other low power uses that do not interfere with the planned use by the Forest Service and the County EMS. Towers 200+ feet in height, or towers requiring lighting by the FAA will not be allowed. This site is approximately 10 ½ miles NE of the Whitetop Communication Site. We have evaluated the possibility of adding the Smyth County 911 system to both of these sites and neither provides the coverage needed. The Forest Service already has a repeater at the Whitetop communication site as well as one at the Mount Rogers NRA office and still experiences dead spots in it’s communications. Additional users are not anticipated at this time, however the 5-acre site will provide for additional users if there is a demand.

Whitetop Communication Site was designated as a communications site on June 2, 1976 by the Regional Forester, and is 10 acres in size, with less than 2.5 acres currently developed. The site is located on USA Tract 969, Longitude 81°36’37”, Latitude 36°38’20” in Grayson, Smyth, and Washington Counties, Virginia. Power exists to the site. The elevation is 5,400 feet and access is via Forest Service Road 89 off of State Route 600. Existing uses consist of private mobile radio systems, amateur radio systems and a resource monitoring system. The Forest also has a repeater/base station for internal communications located at the site. Demand for additional users at this site has been very low for the past 8 years and it is not anticipated that demand will increase significantly in the near future.

NEW CASTLE RANGER DISTRICT

Potts Mountain Communication Site was designated as a communications site on March 12, 1976 by the Regional Forester and is 5 acres in size, although only less than 2.0 acres are currently developed. The site is located on USA Tract 10, Longitude 80°13'06", Latitude 37°32'34", in Craig County, Virginia. Elevation is 3,600 feet and access is via Forest Service Road 177.1 off of State Road 311. Power exists to the site. Existing users consist of commercial two-way radio systems and a wireless telephone service provider, as well as a Forest Service repeater/base station for internal communications. Demand for additional users at the site has been limited to wireless communications in the last 8 years. Demand for additional users is expected to be low and it is not expected that demand for the site will reach the carrying capacity of a fully developed site.

NEW RIVER VALLEY RANGER DISTRICT

Brush Mountain Communication Site was designated as a communications site on August 1, 1996 by the Forest Supervisor and is .01 acre in size. The site is located on USA Tract 527a, Longitude 80°26'50", Latitude 37°16'43", in Montgomery County, Virginia. Allowed uses are limited to low power communications. High power transmitters (100 watt WRP output or greater), radar, or TV transmitters are not allowed. Power and telephone exist to the site. Access is off of US Route 460 via Forest Service Road 188.2. Existing uses consist of administrative use by state, county, and federal governments for private mobile radio systems. The Forest also has a repeater/base station for internal communications located at the site. Demand for additional use of the site is expected to be very low due to the availability of private land in the area. The small size of the site will significantly limit future development.

Butt Mountain Communication Site was designated as a communications site on March 31, 1994 by the Forest Supervisor and is .25 acres in size. The site is located on USA Tract 890g, Longitude 80°37'25", Latitude 37°22'10" and is in Giles County, Virginia. Allowed uses are limited to low power communications. No high power transmitters (100 watt WRP output or greater), radar, or TV transmitters are allowed. Power and telephone exist to the site. Access to the site is via Forest Service Road 714 off of State Road 714. Existing uses include administrative use by state, county, and federal governments, primarily for private mobile radio systems. The Forest also has a repeater/base station for internal communications located at the site. Demand for additional use of the site is expected to be low due to the availability of private land in the area. The small size of the site will significantly limit future development.

Flat Top Communication Site was classified as a communication site by the Regional Forester on August 25, 1977 and is 10 acres in size, with less than 5 acres currently developed. The site is located on USA Tract 106, Longitude 80°51'21", Latitude 37°14'49" in Giles County Virginia. Power exists to the site. The elevation is 4,077 feet and access via Forest Service Road 201 and 612 off of State Route 633. Existing uses consist of commercial mobile radio systems, industrial microwave systems, amateur radio and private mobile radio uses. The Forest also has a repeater/base station for internal communications located at the site. Demand for additional users at the site has been non-existent for the past 8 years, and in fact has decreased with the removal of a microwave tower in 2001. Demand is not expected to increase in the foreseeable future.

Walker Mountain Communication Site was classified June 30, 1976 as a communication site by the Regional Forester and is .5 acre in size, with .3 acre currently developed. The site is located on USA Tract 643, Longitude 81°, 10" 00", Latitude 37°, 01' 00" and is in Wythe County, Virginia. Power exists to the site. The elevation is 3,800 feet and access is via Forest Service Road 206. Existing uses consist of private mobile radio systems and amateur radio use. The Forest also has a repeater/base station for internal communications located at the site. Demand for additional users at the site has been very low and it is not anticipated that future demand will reach the carrying capacity of the site. At the time the site was classified, the Appalachian Trail went directly past the site and a restriction was in place that expansion of the site would not be considered until the planned AT relocation was completed. That relocation has now been completed, however expansion of the site is not being considered at this time. In addition, there is a restriction in place that all future structures on the site must be placed below the horizon of the ridge, and when possible, out of sight of I-77.

Direct, Indirect, and Cumulative Effects

All alternatives designate areas as unsuitable for new communication sites in certain areas (i.e. wilderness and special areas), with Alternatives E and G having the most area, approximately 1/3 of the Forest, designated as unsuitable. In addition to those areas where new sites are unsuitable, all alternatives also discourage or somehow restrict development of new sites in additional management prescriptions, with Alternative E having the most, with restrictions on approximately 74% of the Forest; Alternative G, with restrictions on approximately 70% of the Forest; Alternative A, with restrictions on approximately 67% of the Forest; Alternative B, with restrictions on approximately 62% of the Forest; Alternative I, with restrictions on approximately 61% of the Forest; Alternative D, with restrictions on approximately 45% of the Forest, and Alternative F, being the least restrictive with restrictions on approximately 42% of the Forest.

Although all alternatives have areas where new sites are considered unsuitable and also restricted, the effect on the establishment of a nationwide communication system is negligible. The major demand for new communication sites nationwide is to provide wireless coverage. Due to the interspersed ownership pattern of national forest system lands, with the mountain ridges being in Forest ownership and the valleys being held in private ownership, most wireless sites are best located on private land along major travel ways and not on ridge tops located well away from these roadways. As the wireless communication grid expands to more rural locations, the need for demand for new sites is anticipated to increase, however it is expected that for the most part, in the foreseeable future, this need will be able to be met by locating at existing sites, co-locating on electric transmission towers and other improvements, or by locating on private land.

SOCIAL AND ECONOMIC IMPACT ANALYSIS

DEMOGRAPHIC CHANGES

POPULATION AND MINORITIES

SOCIAL AND ECONOMIC IMPACT ANALYSIS

Social attitudes, values and beliefs are elements used to describe and understand the human perspective of resource management. Social analysis coupled with economic and demographic information forms the human dimension of ecosystem management. This information is used with the biological and physical analyses to best understand potential effects on the land as well as the human environment.

The Jefferson National Forest is located within the southern Appalachian Mountains, which include parts of the Appalachian Mountains and the Shenandoah Valley and extend southward from the Potomac River to northern Georgia and the northeastern corner of Alabama. The southern Appalachian Mountains include seven states and 135 counties, covering approximately 37 million acres. The Jefferson National Forest occupies approximately 723,300 acres, of which about 97% are in Virginia, 2.5% are in West Virginia and less than 1% are in Kentucky. These acres occur in 19 southwestern counties in Virginia, one county in West Virginia and two counties in Kentucky.

Some Forest issues and resource-related activities are localized and may involve only a small area of the Forest, whereas others may involve a state, regional or national perspective. The USDA Forest Service, along with many other federal agencies, completed a broad assessment of this region in 1996, known as the Southern Appalachian Assessment (SAA). One of the components of this analysis is the “Social, Cultural, and Economic Technical Report”, where a social and economic assessment of the southern Appalachian lands was performed. The following assessment of the Jefferson National Forest is tied to some of the more significant SAA findings. An attempt is made to contrast the Forest’s environment with similar findings from the southern Appalachian lands to provide local and regional perspectives. Summary information is provided here, but details are available in Appendix B for this analysis. The following SAA topics will be presented in this section:

- Demographic Changes
- Economic Trends
- Demographic Changes Effect on Natural Resource Management
- Impact of Natural Resource Management on the Economic and Social Status of Local Communities
- Values and Attitudes of Southern Appalachia Residents Toward Natural Resources and Ecosystem Management
- Priorities for Management of Private Land by Non-industrial Owners

Demographic Changes

Demographic changes are compared between the counties with Jefferson National Forest ownership, the state of Virginia and the SAA region. Timeframes of available data are not always comparable. Therefore, direct comparisons between the two are not possible at times. Where available, data from the U.S. Census Bureau for 2000 are included. Because there is often a large variation between individual counties, tables showing the county estimates are given in Appendix B.

POPULATION AND MINORITIES

One characteristic of an area used to determine how dynamic and resilient it is, is the growth of population and its various racial and ethnic components within the counties comprising a national forest. A static area may imply few possible issues affecting change.

SOCIAL AND ECONOMIC IMPACT ANALYSIS

POPULATION AND MINORITIES

POPULATION DENSITY

Conversely, a dynamic growing population may produce many conflicting issues and demands for land managers to consider. Certain areas of the National Forest System and surrounding lands, which are seen to be attractive to urban dwellers for recreation and second or retirement home residence, may produce issues which conflict with traditional residents of the area.

Table 3-206 illustrates population changes for all the counties with Jefferson National Forest ownership, the state of Virginia and the Southern Appalachian Assessment area. Detailed tables for population and race representation for the individual counties are given in Appendix B. Population increased by 7.3% from 1980 to 1990 in the southern Appalachia region. This contrasted with an average 0.5% decrease in the counties comprising the Jefferson NF, and a 16% increase for the state of Virginia. However, the negative trends for Jefferson counties reversed from 1990 to 2000, resulting in a 5% increase. Whereas only 7 of those counties showed an increase from 1980 to 1990, 17 showed an increase from 1990 to 2000. Virginia overall experienced an increase of 14% in population from 1990 to 2000. The Jefferson counties, with the exception of Bedford and Roanoke cities, show a significant difference in the representation of racial and ethnic groups than the state of Virginia but a comparable percent with the SAA region. Individual county minority numbers are shown in Appendix B but the increase in minorities between 1990 and 2000 occurred in many counties, especially in Grayson and Monroe counties and Galax and Roanoke cities.

Table 3-206. Population and Minority Trends for 1980, 1990 and 2000

Location	Percent Population Change '80-'90	Percent Population Change '90-'00	Percent Minority 1990	Percent Minority 2000
Forest Counties	-0.5%	5.0%	7.0%	14.0%
Virginia	16.0%	14.0%	23.0%	26.0%
SAA	7.3%	*	8.1%	*

* No SAA estimate for 2000; Source: U.S. Census Bureau

POPULATION DENSITY

Population density shown in Table 3-207 was 102 people per square mile in the SAA in 1990, while the population density for the forest was 88 people per square mile, and 156 people per square mile for the state of Virginia. Population density in 2000 increased to 179 persons per square mile in the state while the forest counties increased to 92. Appendix B displays the variation among the individual counties for population density.

Location	1980 Population Density Persons/Square Mile	1990 Population Density Persons/Square Mile	2000 Population Density Persons/Square Mile
Forest Counties	88	88	92
Virginia	135	156	179
SAA	94	102	*

* No SAA estimate for 2000; Source: U.S. Census Bureau

Table 3-207. Population Densities in 1980, 1990, and 2000

The significance of these population changes is that the forest boundary population actually decreased for the 1980 to 1990 decade while that of the SAA and the state of Virginia increased. However, population in the Jefferson counties grew rapidly from 1990 to 2000 for the Forest counties but was still half the growth rate for the entire state of Virginia. This population appears to be moving not to urban areas within these counties but to the rural areas. Population in several of the cities within the Jefferson National Forest area actually decreased, while neighboring county populations increased.

PER CAPITA INCOME

Per capita income is a relative measure of the wealth of an area. It constitutes the personal income from all sources divided by the population of that area. Table 3-208 shows that for the SAA area the per capita income average was $10,950 in 1990, for the forest analysis area it averaged $10,648 and for the state of Virginia it was $15,713. Income for both the forest area and Virginia grew faster on a real basis (inflation-adjusted) than the SAA during the 1980's. In 2000, the forest area average rose to $17,034 and the Virginia state average rose to $23,975. However, on an inflation-adjusted basis, real income increases were minimal, in fact decreasing for the state of Virginia. The large variation among the counties is exhibited in Appendix B.

Location	1980 Per Capita Income	1990 Per Capita Income	2000 Per Capita Income	Real Avg. Annual % Change '80-'90 Per Capita Income	Real Avg. Annual % Change '80-'90 Per Capita Income
Forest Counties	$5,739	$10,648	$17,034	1.6%	0.1%
Virginia	$7,475	$15,713	$23,975	2.8%	-0.4%
SAA	$6,377	$10,950	*	0.8%	*

*No SAA estimate for 2000; Source: U.S. Census Bureau

Table 3-208. Per Capita Income in 1980, 1990 and 2000

UNEMPLOYMENT AND POVERTY

Other indicators of relative economic prosperity are the percent of the workforce out of work and percent in poverty, as shown in Table 3-209. Unemployment rates vary dramatically over time, depending in large part on the national economy. Some areas, however, have protracted unemployment problems because of educational attainment and lack of skills. The average unemployment rate for forest analysis area counties in 1997 was 5.7%, which is higher than Virginia's average of 4.0%. Many of the Jefferson area counties had very high percentages in poverty in 1989. The average was much higher for the forest county average than for either Virginia or the SAA, which had an average of 10.7%. The percent in poverty maintained those same trends in 1999. Individual counties are shown in Appendix B.

Location	1990 Unemployment Rate	1997 Unemployment Rate	1989 Percent of All Ages in Poverty	1999 Percent of All Ages in Poverty
Forest Counties	7.9%	5.7%	16.9%	14.7%
Virginia	4.3%	4.0%	10.2%	9.6%
SAA	6.5%	*	10.7%	*

No SAA estimate for 1997, 1999; Source: U.S. Census Bureau, Small Area Income and Poverty Estimates Program

SOCIAL AND ECONOMIC IMPACT ANALYSIS

HOUSEHOLDS AND HOUSING UNITS

Table 3-209. Unemployment Rates and Percent in Poverty for the Jefferson Area

HEADS OF HOUSEHOLDS

Another factor indicating relative poverty and social disunity for an area is the percent of households headed by a female member. The greater this percentage is, the more likely that these households may be on some form of government assistance. A lower female head of household percent may indicate greater social cohesion from the extended family. The average percent of households headed by a female for the Southern Appalachian region in 1990 was 10.5, which is significantly higher than the Forest area or the state of Virginia in 1990. The number of persons per household also indicates economic status in a region. The greater the average number of persons per household, the less prosperous the area tends to be. Table 3-210 below contrasts the experience for the three areas of comparison.

The Jefferson National Forest counties had fewer persons per household than Virginia or the SAA in 1990. The lower trend continued in 2000 for counties in the analysis area. Households headed by a female were much lower in the Jefferson counties in 1990 than that of the state or SAA. There was a significantly greater percentage of elderly households in the forest counties than for the state of Virginia. Such a condition may reflect a loss of youth from the area.

Location	1990 Persons per Household	2000 Persons per Household	1990 Percent of Female Head of Households	2000 Percent of Female Head of Households	1990 Percent of Age 65+ Households	1990 Percent of Age 65+ Households
Forest Counties	2.53	2.36	4.40%	5.60%	25.40%	25.70%
Virginia	2.61	2.54	5.80%	6.90%	20.80%	20.90%
SAA	2.6	*	10.50%	*	*	*

* No SAA estimate available; Source: U.S. Census Bureau

Table 3-210. Household Data for 1990 and 2000

HOUSING UNITS AND VALUES

The decade of the 1970's appears to be a decade of more rapid growth than the decade of the 1980's as shown in Table 3-211. Housing unit growth from 1970 to 1980 was 34.3% for the Forest area, while Virginia showed a slightly larger growth rate of 35.3%. Growth then slowed progressively down until 2000 for Virginia. However, it dropped at a greater rate from 1980-1990 for the Jefferson counties before picking back up from 1990-2000. Housing unit change was not measured in the SAA. Individual counties are compared in Appendix B.

Location	Housing Units Percent Change 1970-1980	Housing Units Percent Change 1980-1990	Housing Units Percent Change 1990-2000
Forest Counties	34.3%	9.4%	16.1%
Virginia	35.3%	23.5%	16.3%

Source: U.S. Census Bureau

Table 3-211. Housing Unit Changes, 1970-2000

Median housing value is contrasted in Table 3-212. Housing values within the forest analysis area tend to be substantially below that of Virginia and the SAA. Housing values are determined principally by the extent of demand. The greater the demand, the higher prices are bid up. Population and job increases play a factor in the extent of demand for housing. Population has only begun to increase at a significant rate in the 1990's. The prior decade population either decreased in most areas or grew at a small pace. Housing stock increased at a significant rate in the decade of the 1970's and 1980's. However, value is still low compared with the State, which has the influence of urban areas that can support higher priced housing. At any rate, it appears that the forest analysis area is fairly dynamic as far as new home additions. Population and wage growth will have to increase significantly to warrant significant increases in housing values.

Location	Housing Units Median Value 1980	Housing Units Median Value 1990	Housing Units Median Value 2000
Forest Counties	$33,674	$52,332	$81,416
Virginia	$48,100	$91,000	$125,400
SAA	*	$59,700	*

* No SAA estimate available; Source: U.S. Census Bureau

Table 3-212. Housing Median Values in 1980, 1990, and 2000

Economic Trends

Analyzing the major economic sectors of an economy allows insight into the degree of diversity and what industries may be driving its growth. Table 3-213 shows the entire local economy broken out by major Standard Industrial Code (SIC) and by important industry sub-sectors for wood products and for an estimate of the contribution of certain industries to tourism. Tourism is not an individual sector of an economy but comprises several of the services and retail industries. The percentage of each of these industries attributed to tourism was taken from the work of Gordon McClung at West Virginia University. A more detailed breakdown of these sectors is included in Appendix B.

Sector	Industry Output % Total 1985	Industry Output % Total 1996	Employment % Total 1985	Employment % Total 1996
Agriculture	2.4%	1.2%	4.8%	2.1%
Mining	9.9%	4.7%	5.0%	1.5%
Construction	5.8%	9.7%	5.5%	7.7%
Other Manufacturing	28.6%	18.2%	18.7%	8.1%
Wood Products Manufacturing				
Mfg.--SIC 24 Lumber & Wood Prods.	0.7%	3.2%	0.9%	1.5%
Mfg.--SIC 25 Wood Furniture & Fixtures	1.5%	1.2%	1.9%	1.0%
Mfg.--SIC 26 Paper & Pulp Products	0.7%	0.2%	0.4%	<0.1%
Recreation Related Services	0.2%	0.0%	0.2%	0.0%
Other Recreation Related Industries	1.3%	2.5%	0.1%	3.7%
Transportation & Utilities--Non-Tourism	9.6%	10.0%	6.4%	4.1%
Finance, Insurance, Real Estate	6.2%	12.5%	4.6%	4.8%
Services--Non-Tourism	9.7%	17.1%	16.5%	22.5%
Wholesale & Retail Trade--Non-Tourism	11.9%	14.0%	18.8%	21.4%
Government	11.3%	5.2%	15.1%	21.1%
Other--Misc.	0.2%	0.2%	1.1%	0.5%
TOTAL	100.0%	100.0%	100.0%	100.0%

Source: IMPLAN 1985 and 1996 Data

SOCIAL AND ECONOMIC IMPACT ANALYSIS

ECONOMIC TRENDS

Table 3-213. Economic Diversity in the Jefferson National Forest Analysis Area

From Table 3-213 it is evident that the forest analysis area economy is becoming less reliant on the manufacturing sector. Although its importance decreased by 10.3% of the total output from 1985 to 1996, manufacturing remains the largest proportion, representing 18% of the economy output in 1996. Similarly mining, an important industry in extreme southwestern Virginia, has decreased as a significant sector. Government Services also decreased in output but three major sectors increased dramatically from 1985 to 1996: Finance, Insurance and Real Estate; Non-Tourism Services; and Non-Tourism Wholesale and Retail Trade.

Of the manufacturing sector, wood products represented a 4.7% share of the local economy's total output in 1996, compared to a 2.9% share in 1985. Employment share decreased from a 3.2% share in 1985 to 2.5% share in 1996. Employment in the wood products industries resulted in a 3.4% share of the SAA economy in 1991. Industrial production had a 5.2% share.

Tourism is defined as any non-business related travel of 100 miles or more from home. Recreation would be a subset of the tourism estimate; therefore its share of the economy would be something less than the tourism numbers.

The estimate of tourism's share of the economy increased from a 1.5% to a 2.5% share of output between 1985 and 1996. Employment, meanwhile, increased from a 0.3% to a 3.7% share of the local economy's total.

A principle way an economy grows is by export of goods and services. Most typically, manufacturing activity is thought of as providing most of this export related activity. However, services and retail trade can be considered "export" industries if significant visitors come in from outside in travel related activities to bring in new dollars. Tourism is classified as an export driven activity. A manufacturing industry can be a net importer if it imports more of a commodity that it exports.

Table 3-214 shows that the economy around the Jefferson was a net importing economy in 1985 ($2,460 million) but became greatly less dependent on imports in 1996 (-$299 million). The Mining sector decreased in net exporting but still involved an 18% share of the positive net exporting industries. The Lumber and Wood Products sector went from a net importer in 1985 to a net exporter in 1996, moving up to 10% of the total positive exporting industries. The Wood Furniture and Wood Products sector remained a steady net exporter in both 1985 and 1996. The Paper and Pulp Products sector grew as a net importer from 1986 to 1996. Tourism rose during those years from being a net importer to a net exporter, representing a significant portion of the exporting industries, up to 27%.

Commodity	1985 Net Exports - Exports Less Imports	1996 Net Exports - Exports Less Imports	1985 Net Exporting Industries as a Percentage of Total Positive Exporting Industries	1996 Net Exporting Industries as a Percentage of Total Positive Exporting Industries
Mining	$1,232.2	$765.5	55.9%	17.7%
Other Manufacturing	($877.0)	($2,436.6)	0.0%	0.0%
Mfg.--SIC 24 Lumber & Wood Prods.	($34.6)	$446.7	0.0%	10.3%
Mfg.--SIC 25 Wood Furniture & Fixtures	$242.2	$269.5	11.0%	6.2%
Mfg.--SIC 26 Paper & Pulp Products	($105.3)	($212.6)	0.0%	0.0%
Total Manufacturing	($774.6)	($1,933.0)	0.0%	0.0%
Total for Commodities in Tourism Estimate	($506.8)	$1,197.4	0.0%	27.7%
Estimate of Trade in Tourism	($49.7)	$150.9	0.0%	3.5%
Total Net Trade (exports)	**($2,459.7)**	**($299.5)**		
Total Positive Trade Industries (exports)	**$2,205.1**	**$4,330.3**		

Source: 1985 and 1996 IMPLAN data

Table 3-214. Net Exports in Jefferson National Forest Analysis Area, 1985 and 1996 (dollars are in millions)

The Jefferson economic impact analysis area can be contrasted with the SAA, which was a net exporter in 1991 of goods and services of $25.5 billion. Manufacturing was the largest net exporting sector, representing 24.6 billion. Thus, manufacturing represented 96.5% of the net exports in the SAA. Construction (-$6.7 billion) and Services (-$4.3 billion) were the largest net importers and contributed to a drain of money from the SAA economy.

Another way to indicate diversity of an economy is with the Shannon-Weaver Entropy Indices of diversity. This process allows a relative measure of how diverse a county is with a single number. The entropy method measures diversity of a region against a uniform distribution of employment where the norm is equi-proportional employment in all industries. All indices range between 0 (no diversity) and 1.0 (perfect diversity). These two extremes would occur when there is only one industry in the economy (no diversity) and when all industries contribute equally to the region's employment (perfect diversity). Another factor affecting the magnitude of the index is the number of industries in a local economy; the greater number, the larger the index.

Table 3-215 contrasts the change in economic diversity from 1977 to 1993 at the four digit SIC (industry) level for a few areas. For a point of reference, Virginia and the United States serve as comparison guides. Appendix B lists all of the counties and independent

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ECONOMIC DIVERSITY

cities for the Jefferson analysis area. All counties showed an increase from 1977 to 1993. The county experiencing the greatest change in economic diversity from 1977 to 1993 was Monroe, followed by Dickenson, Rockbridge, Grayson and Craig counties. However, Dickenson county still ranked the fourth lowest of all. In 1993, the least diversified was the city of Galax and the most was the city of Roanoke. All counties and independent cities in the Jefferson area still remained below the averages for the State of Virginia and the United States, although most showed 20% or more increases from 1977 to 1993.

	1977 Four Digit SIC	1993 Four Digit SIC	% Change from 1977 to 1993
Virginia Counties			
Craig	0.36164	0.55282	53%
Dickenson	0.31303	0.53687	72%
Grayson	0.36860	0.56477	53%
Rockbridge	0.33322	0.54857	65%
Virginia Independent Cities			
Galax	0.48913	0.51143	5%
Roanoke	0.56207	0.65905	17%
West Virginia Counties			
Monroe	0.31121	0.57755	86%
State of Virginia	0.48121	0.70084	46%
United States	0.66483	0.73973	11%

Source: USDA Forest Service, Institute of Monitoring and Inventory

Table 3-215. Shannon-Weaver Entropy Diversity Indices for selected areas of the Jefferson Analysis Area, 1977 and 1993

25% FUNDS AND PAYMENTS IN LIEU OF TAXES

Twenty-five Percent Funds and Payments in Lieu of Taxes are funds that the federal government provides to states to help offset the non-tax status of federal lands within their boundaries. Historically, 25% Funds have been 25% of Forest Service revenues from collected commodity receipts, such as those from timber sales, mineral resources, grazing fees, etc. that have been returned to states in which national forest lands are located. The states then transferred these payments to counties for public schools and roads, but payments particularly fluctuated from year to year as markets for high-yield timber ebbed and national feelings changed regarding traditional practices like timber sales. The Secure Rural Schools and Community Self-Determination Act of 2000 now offers a new payment formula that gives counties an alternative to receiving funding under the traditional 25 percent fund. The new formula is based on averaging a state's three highest payment amounts between 1986 and 1999 to arrive at a compensation allotment or “full payment amount.” A county may choose to continue to receive payments under the historic formula or to receive the county's proportionate share of the state's full payment amount. The Act also creates resource advisory committees and gives local communities the choice to fund restoration projects on federal lands and/or fund county projects.

The Payments in Lieu of Taxes Act of 1976 (Public Law 94-565) provides payments to local units of government (generally counties) that contain federally-owned lands. Payments are based on the county populations and the amount of federal acres, along with other variables. PILT is a payment from the Bureau of Land Management that is reduced by any funds contributed to a county by the Forest Service’s Payments to States.

Table 3-216 illustrates the trends in 25% Funds and PILT for the Jefferson. Individual county comparisons are given in Appendix B.

Source	1988	1991	1994	1997	2000
PILT	$327,427	$373,938	$413,083	$373,824	$551,077
25% Funds	$191,748	$307,281	$276,577	$313,173	$208,658
Total	$521,163	$683,210	$691,654	$688,994	$761,735

Source: U.S. Bureau of Land Management and U.S. Forest Service

Table 3-216. Payments in Lieu of Taxes and 25% Fund to Counties with Jefferson National Forest Ownership

Land use and its change over time is an indicator of the dynamics of an area. Areas converting from rural uses to urban uses have implications of changes that affect residents. Table 3-217 below shows the land use of weighted average acres for the Virginia counties in the forest analysis area in 1992. A detailed analysis, by county, is given in Appendix B.

	Percent Forested	Percent Agricul-tural	Percent Residential	Percent Water	Percent Quarries, Strip Mine, Gravel Pits	Percent Transitional
Forest Weighted Average	74%	23%	2%	1%	<1%	<1%

Source: Virginia National Land Cover Data Set, U.S. Geological Survey and U.S. Environmental Protection Agency, 1992

Table 3-217. Land Use in Jefferson Area Counties, 1992

The SAA found that little forest land was lost between 1970 and 1990 in that region. However, urban, road and housing development growth caused by increased population in the area took farmland, pastures and open space. Retirees and commuters from nearby urban centers were responsible for part of that demand for development.

The Southern Forest Resource Assessment, 1999, stated the following conclusions: "Compared to earlier periods, land use in the South has been fairly stable since 1945. The most notable exception is Florida, where developed land uses have expanded substantially. However, an evaluation of land use dynamics between 1982 and 1992 indicates that while total forest area has been stable, the stability is the result of substantial offsetting changes into and out of forest cover. As a result, much of the southern forest landscape has experienced significant change. Two dominant forces strongly influenced recent land use changes: (1) urbanization driven by population and general economic growth and (2) changing relative returns to agriculture and timber production. We expect their influences to continue. As a result of anticipated population and economic growth, rural land will be converted to urban uses. As a result of increases in timber prices, some agricultural land will become forested. Depending on assumptions about future timber prices, forecasts of land uses indicate that the South could experience a net loss of from 8 to 12 million acres of forest land (roughly 5 to 8%) between 1992 and 2020. Forest losses are likely to be concentrated in four areas: (1) the Piedmont and Mountain areas of North Carolina; (2) adjacent Piedmont areas of South Carolina and Georgia; (3) northern peninsular Florida; and (4) the Atlantic and gulf coastal areas. Other areas with substantial projected losses are around the cities of Nashville, TN, and Birmingham, AL, and in northern Virginia between Washington, DC, and Richmond, VA. Gains in forest land at the expense of agriculture are likely in other regions of the South. In the eastern part of the South, forest gains are possible in two relatively small areas: (1) the upper Coastal Plain of Georgia; and (2) an area centered on the boundary between North Carolina and Virginia in the Coastal Plain. In the western part of the South, forest gains are possible in the lower Gulf Coastal Plain in Alabama and in large portions of Arkansas, Mississippi, and Louisiana. Overall losses in forest in the eastern part of the region will likely be offset by gains primarily in the western part of the region."

Summary of Demographic and Economy Changes

Demographic and economic indicators within the Jefferson National Forest analysis area indicate that there are six distinct geographic separations with similar characteristics:

- The extreme southwest corner of Virginia and counties in Kentucky: Dickenson, Lee, Scott, Wise, Letcher and Pike counties and the city of Norton
- The Interstate 81 corridor: Pulaski, Rockbridge, Roanoke, Smyth, Washington, Wythe and Montgomery counties and the cities of Roanoke, Salem and Radford
- The Mount Rogers National Recreation Area: Grayson, Smyth, Washington and Wythe counties and the cities of Bristol and Galax
- Roanoke and surrounding counties: Roanoke County and city, Salem city, and Botetourt and Craig counties
- The northwestern edge of the forest: Bland, Giles, and Tazewell counties
- Individual areas: Monroe County in West Virginia, Bedford County and city

SOUTHWEST CORNER OF VIRGINIA

All of this area experienced negative population growth in both the 80's (average of -10%) and 90's (average of -3.5%). The exception was Wise county, which actually increased 8% from 1990 to 2000. The minority representation in this area has remained at about 1% over the past ten years with the exception of the city of Norton, which has around 8%. Not considering the city of Norton, the population density is currently averaging around 69 persons per square mile. The per capita income for this area averaged $8,518 in 1990 and rose to $13,972 in 2000, which is still $10,003 lower than the state of Virginia average and $3,062 lower than the total forest county average. The unemployment rate in 1997 was an average of 9.9% for this area, with Wise county at 12.3% and Dickenson county at 16.8%. The average percent of persons in poverty decreased from 25.9% in 1989 to 22% in 1999 but all counties had over 20% for both time measurements. The median housing value was $39,314 in 1990 and $59,400 in 2000, which is almost one half the median housing value for the state and ¾ the housing value for the forest average. The average Shannon-Weaver Diversity index value for this area is 0.5576. However, it is interesting to note that Dickenson county in particular increased 72% in its economic diversity value measured in 1977 compared to 1993, while other counties averaged an increase of 13 to 33%. The counties in Kentucky averaged an increase of 45% in economic diversity. Dickenson county is 94% forested and 3% agricultural; Scott county is 88% forested and the remainder agricultural; and Wise county is 88% forested with 4% agricultural and 4% in quarries, strip mines and gravel pits.

INTERSTATE 81 CORRIDOR

Population in this area along the I-81 corridor experienced a mixture of negative and positive growth in the 80's, ranging from a decrease of 4% to an increase of 16%. All of the area, however, with the exception of Roanoke city, showed an increase in population in 2000, ranging from 2% to 13%. Montgomery county maintained a significant increase in population during both decades (16% and 13%). The county population density has steadily increased to an average in 2000 of 132 persons per square mile. The per capita income average in 1990 was $12,062 and $18,399 in 2000, both of which were greater than the forest average. Unemployment in 1997 was an average of 4.5%, which is around the state average and well below the forest average. Percent of persons in poverty averaged 15.6% in 1989 and decreased to 14% in 1999. However, Montgomery county had 23% of persons in poverty for 2000 and Radford city had 31%. The median housing value for 1990 was $61,640 and $92,030 in 2000, which is ¾ of the state average and above the forest average. Economic diversity as measured by the Shannon-Weaver index was an average of .6006 in 1993 but Rockbridge county showed an increase of 65% for its index value between 1977 and 1993.

MOUNT ROGERS NATIONAL RECREATION AREA

The Mount Rogers National Recreation Area provides a unique combination of natural resources that are important to a wide variety of local, regional and national users with sometimes conflicting needs and desires for its management. All of the area surrounding the Mount Rogers National Recreation Area experienced a slight average decrease (-2%) in population in the 80's but an average of 7% increase in the 90's. The minority representation in this area has remained around 2-3% with the exception of Grayson county where it has grown from 3% to 8% from 1990 to 2000 and from 7% to 13% for the city of Galax. The county population density has remained fairly steady at an average of 65 persons per square mile in 2000. Per capita income rose from $10,073 in 1990 to $17,156 in 2000, which is around the average for the forest. Unemployment for this area was an average of 5.6% in 1997 and poverty decreased from 16.9% in 1989 to 13.7% in 1999. The median housing value increased from $45,900 in 1990 to $73,143 in 2000. The average Shannon-Weaver Index value for measuring economic diversity was 0.5936, a notable increase from 1977 to 1993 was Grayson county, which rose 53% in its measure.

ROANOKE AND SURROUNDING AREA

This area is separate because of it contains the highest concentration of population within the forest area. Population has experienced a slight decrease in the cities of Roanoke and Salem but a more significant increase in the 90's for the surrounding counties. Botetourt county in particular has increased 22% from 1990 to 2000. Although Craig county has a small population base, it does contain over 50% of National Forest ownership so a population growth of 16% can be considered a significant factor. Minority representation in Craig county has remained around 1% but an average of 4-6% for Botetourt county, Roanoke county and the city of Salem and 29% for the city of Roanoke. The average per capita income for this area was $13,721 in 1990 and $20,547 in 2000, both of which were above the average for the forest. Unemployment averaged 3.4% in 1997, which was below the average for the state of Virginia. The percent of persons in poverty remained about the same at 8.3% in 1989 and 8.5% in 1999. The median housing value for the area was $49,505 in 1990 and $103,700 in 2000, which is considerably above the average for the forest. The economic diversity measure (Shannon-Weaver index) average was 0.6115 and it is interesting to note that the index for Craig county increased 53% from 1977 to 1993.

TAZEWELL, GILES AND BLAND COUNTIES

This area is along the northwestern boundary of the forest, away from the Interstate 81 corridor. Population changes have been variable, with an 8-9% decrease in 1990 for Tazewell and Giles counties to a 2-5% increase for Giles and Bland counties in 2000. The

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DEMOGRAPHCH EFFECTS ON NATURAL RESOURCE MANAGEMENT

representation of minorities has remained around 2-5%. The median housing value rose from $46,233 in 1990 to $69,533 in 2000. Per capita income increased from $10, 407 in 1990 to $17,140 in 2000, which is around the forest county average. Unemployment averaged 7.5% in 1997, which is above the average for Virginia. Poverty decreased from 13.7% in 1989 to 12.4% in 1999. The economic diversity index for this area is 0.5582.

BEDFORD AND MONROE COUNTIES

Both of these counties are unique in that they do not fit into any of the other geographic groupings and they both showed dramatic changes over the past ten years. Bedford county has experienced significant increases in population in both the 80's and 90's. Monroe county grew at a 17% rate for population in the 90's. Unemployment was 5.8% in 1997 but poverty was 21% in 1990 and 16.2% in 2000. The minority representation in Monroe county grew from 1% in 1990 to 7% in 2000. Monroe county's economic diversity index rose 86% from 1989 to 1999, where it is now 0.57755.

Demographic Changes and the Effects on Natural Resource Management

The Southern Appalachian Assessment found that while little forest land has been lost since 1970 in the region, growth from urban, road and housing development caused by increased population, has taken farmland, pastures and open space. Retirees and commuters from nearby urban centers are responsible for part of this demand for development.

Newcomers to the region can feel differently than long-time residents about natural resource preservation. Often, the latter's livelihood depends upon manufacturing from natural resources. Managers of natural resources have had to respond to new sets of values and preferences, particularly increased demand for land and water resources for scenery, recreation and tourism.

Population in the Southern Appalachian region is projected to grow by 12.3% by 2010, slightly less than the growth rate expected for the nation (13.1%). Most of the growth is expected to be in northern Georgia, western North Carolina, and portions of eastern Tennessee and northwestern Virginia. Virginia's population is expected to increase 9% by 2010 and 21% by 2025.

The increase in population density across all counties in the southern Appalachian region has impacted farms, forests, and pastures and has removed habitat for most species of wildlife and fish. More people entering the area has resulted in greater amounts of land conversion and impacts to water quantities, quality, and use. At higher elevations, development has impacted visual qualities.

As certain areas of the southern Appalachians have been developed, more urban pressures have impacted the land. Private lands have become posted as "off limits", causing public lands to become more crowded. This greater private land restriction has put more pressures on public land to accommodate increased demands for tourism and recreation.

Personnel from Region 8 and the Southern Research Station compiled a number of questions they felt could be used in a survey design to poll people within 75 miles of the forest boundary to learn how people perceive natural resource management. Answers to these survey questions can help national forest planners with knowledge of (1) their values, attitudes, and beliefs at the forest level; (2) respondents' participation activities on national forest lands; (3) their feelings toward natural resource management in general; (4) how they believe the national forests should be managed; and (5) how concerned the respondent is about various environmental issues in the southern

Appalachians. The results are from the "Public Survey Report, Public Use and Preferred Objectives for Southern Appalachian National Forests", USDA Forest Service, Southern Research Station. The forest market area includes all counties within a 75-mile radius of the boundary of the forest. A sub regional market area includes all the counties within the combined 75-mile radii of the forests covered by the report.

Data specific to the Jefferson are given in Appendix B but summary findings are presented here. Almost 98% of people, age 16 and over, live year-round in the Jefferson market area, leaving only 2% of seasonal residents. Only 45% of the area residents surveyed had lived in the Southern Appalachian region their entire lives and 60% had lived there more than 20 years. A little over 20% had lived there less and 10 years, however, indicating a fairly sizable portion of the population that has been mobile. For people living in the Jefferson market area, a majority (over 52%) remains in the area because of family ties. Very few (around 7%) remain for their jobs and almost 17% remain because of attachment to the area itself.

Around 20% of responding residents are owners of 5 or more acres of rural land. About 24% are under age 30 and about 29% are over age 55. Most of the surveyed population

Table 3-218. Jefferson National Forest Ownership by County

	1983 Ownership	1983 % of County in JNF Ownership	2000 Ownership	2000 % of County in JNF Ownership
Virginia Counties				
Bedford	18,478	3.8	18,810	3.9
Bland	70,559	30.8	74,665	32.5
Botetourt	64,803	18.6	67,977	19.6
Carroll	5,575	1.8	7,286	2.4
Craig	114,799	54.3	116,509	55
Dickenson	8,235	3.9	8,235	3.9
Giles	61,546	26.6	63,394	27.7
Grayson	32,216	11.2	33,079	11.7
Lee	11,873	4.2	11,335	4.1
Montgomery	19,231	7.6	19,455	7.8
Pulaski	19,291	9.5	19,029	9.3
Roanoke	3,016	1.5	3,140	2
Rockbridge	21,182	5.5	21,276	5.5
Scott	34,172	10	34,580	10.1
Smyth	71,690	24.8	77,474	26.8
Tazewell	7,797	2.3	9,804	2.9
Washington	21,789	5.9	22,301	6.2
Wise	34,739	13.2	36,180	14
Wythe	56,829	19.1	58,299	19.7
West Virginia Counties				
Monroe	18,380	6.1	18,530	6.4
Kentucky Counties				
Letcher	845	<1	845	<1
Pike	116	<1	116	<1
State of Virginia	677,820	2.7	702,828	2.8

is between the ages of 30 and 55. Around 90% are Anglo, non-Hispanic whites, 6% are Black and 2% are Hispanic. Less than 1% are foreign born. Around 9% have less than a high school education and around 17% have a diploma or some college experience. About 57% work a job while over 43% are retired. Increasingly, the national forests with their natural and scenic amenities are popular retirement locations.

Impact of Natural Resource Management on the Economic and Social Status of Local Communities

As shown in Table 3-218, national forest lands comprise a significant percentage in several counties, making consideration of the impacts of forest management on the economic and social status of local communities a major concern.

Note especially that Bland, Craig, Giles and Smyth counties have over 25% of the county acreage in National Forest ownership and likely would depend heavily on 25% funds and PILT payments as a replacement of property tax revenues.

The Southern Appalachian Assessment found that residents of communities near public land are sensitive to land management choices, sometimes economically and sometimes culturally. For the Jefferson, the communities in southwest Virginia are still in a lower economic status than the rest of the state. Likewise, their economy can be heavily dependent on natural resources, whether through extraction or tourism. In the extreme southwest portion of the Jefferson, the mining industry is especially important whereas manufacturing and wholesale/retail trade is important in other counties within the forest boundary.

Values and Attitudes of Southern Appalachia Residents Toward Natural Resources and Ecosystem Management

Natural resource management attitudes and values that residents of the SAA hold are extremely important for land managers to realize. Research done during the SAA analysis showed that most people felt that environmental protection and economic growth can be compatible. However, when people had to choose between the two, their first choice was the environment. Most people felt that environment protection has not gone far enough. SAA residents have indicated a willingness to put more personal funds toward collective environmental protection but how they would do this was not elaborated upon in the survey.

Furthermore, the SAA found that as retirees, urban transfers, and other new residents move into the SAA region, concerns for the health and aesthetic appearance of the region's ecosystems were likely to strengthen.

The Assessment found that about 150 environmental groups have some effect on public land management in the region, largely through technical assistance to management agencies and through public outreach and environmental education activities.

Federal land managers perceive that environmental groups influence management of public land in the region through their impacts on planning proposals and environmental impact statements. As the region grows as a tourism destination, pressures for environmentally and aesthetically sensitive management options also will grow.

In the Journal of Forestry article *Changing Demographics, Values, and Attitudes*, H. Ken Cordell and Michael Tarrant, October/November 2002, pp. 31-32, it was found that the magnitude of upward trends in population, changes in demographic makeup, and rising demand for recreation suggest there likely are other significant social changes in the South. Among such possible changes are the values and attitudes people hold toward the natural environment in general and forests in particular. In rapidly urbanizing areas of the

South, there have been dramatic decreases in the amount of and access to forested or other natural lands. A changing population and decreasing forest resources have led to changes in the values and attitudes Southerners hold toward forests. Below is a discussion of values, attitudes, and demographics found in the Southern Forest Resource Assessment (SFRA).

VALUES

Published literature and survey results from the SFRA both indicate that private forest owners and the public as well rank “conservation” higher now than in past decades. Recently there been a growing concern in the public’s view that environmental quality is more important than commodity benefits from forests and other natural lands. In the survey designed specifically for the SFRA, Southerners confirmed that environmental benefits from forests are valued higher than commodity benefits. Wood as a production commodity was rated as least important of four listed values (wood products, clean air, scenic beauty, and heritage) associated with forests (Tarrant et al., in press). Clean air was listed as most important. When survey respondents were asked about values of public forests as distinct from private forests, some differences were noted. Producing wood products was valued higher if it were to come from private forests while clean air was valued higher if coming from public forests. These results indicate that Southerners hold measurably stronger environmental values and more restrictive commodity values about public forests than they hold for private forests.

Respondents to the SFRA survey were asked if they or their spouse owned any rural land of 10 acres or more. When a comparison was made between those reporting owning land and those who did not, little to no significant differences regarding forest values were evident. The single exception was that landowners rated wood products as a more important use for private forests than did non-landowners. Furthermore, there were no significant differences between the two groups in attitudes toward the environment. Overall, results suggest that land ownership has relatively little bearing on southern residents' values of forests or attitudes toward the environment.

ATTITUDES

While values indicate the relative good or worth of forests, attitudes represent levels of agreement with particular forest conditions or environmental issues, such as regulatory laws or policies. Based on results from the survey done for the SFRA, a majority of Southerners felt that “too little” was being spent on protecting the environment (62.5%). Only 9.2% reported they felt “too much” was being spent. Similarly regarding environmental laws, 45.5% indicated environmental laws had “not gone far enough”, while only 13.1% thought environmental laws had gone “too far.” But, as in the Jefferson survey, ‘environmental laws’ were not elaborated upon or resource selective, so blanket coverage of environmental laws could be interpreted to mean limiting toxic waste dumps, to toughening endangered species laws on private lands. It could also mean that everyone wants clean air and water. No reference or distinction was made whether or not the enforcement of existing laws would achieve the desired results of the stated ‘environmental protection’ or regulation.

An overall mean score of 23.8 on the modified New Ecological Paradigm used in the SFRA survey (midpoint of 30 with a range of 10, highly favorable, to 50, highly unfavorable) suggests a moderately strong pro-environmental attitude among people of the South.

Another source of people values, beliefs and attitudes is from the telephone Public Survey Report, with detailed tables given in Appendix B. As shown in Table 3-219, provision of recreation, timber, grazing and raw materials ranked lower than protection for clean water, wildlife, forest health and rare or endangered species.

Table 3-219. Values of Local Residents (Percentages Important/Extremely Important)

Personal and Household Characteristics	Jefferson NF (N=1403)	Southern Appalachian Region	National
Maintain for future generations	94.3/86.1	92.7/83.7	92.5/80.4
Protect sources of clean water	94.9/88.7	94.0/86.3	94.1/82.7
Provide protection for wildlife	90.8/74.8	88.8/72.4	88.0/69.4
Leave them natural in appearance	89.9/74.1	85.9/68.6	85.6/64.3
Emphasize healthy forests	90.3/74.7	87.7/70.5	n/a
Protect rare or endangered species	84.7/71.3	83.1/69.7	84.7/67.1
Provide information and educational services	82.8/59.6	80.1/55.9	79.1/52.5
Provide natural places for personal renewal	80.8/60.8	75.8/54.2	73.9/49.1
Provide outdoor recreation	77.3/51.9	74.1/47.8	73.4/44.8
Provide abundant timber supply	71.1/54.7	72.3/54.8	77.7/57.6
Help local tourism businesses	57.8/37.4	57.3/36.0	56.0/31.1
Permit grazing of livestock	45.3/26.5	45.2/26.5	49.8/28.0
Provide raw materials and products for local industries	37.7/22.6	38.7/22.3	45.1/24.9

Source: National Survey on Recreation and the Environment, Version 12, November 2001 to April 2002. National percentages are from NSRE Version 6 and 7, September 2000 to March 2001.

The public survey also provided information on the values residents have relating to natural resource management activities and to the resources themselves, shown in Table 3-220. Over 90% of the sample in the Jefferson forest market area thought protection of clean water and wildlife habitat was an important management goal for national forests. Old growth protection and provision of watchable wildlife viewing areas were the next most important.

DEMOGRAPHIC DIFFERENCES IN VALUES AND ATTITUDES

In the “Changing Demographics, Values, and Attitudes” article by H. Ken Cordell and Michael Tarrant, a number of comparisons of values were made between different social groups in the South. They included urban-rural, age, length of residency, and gender. These comparisons revealed that where people live in the South (urban or rural) is not related to their values or attitudes toward forests and the environment. However, age did influence public values toward forests and environmental attitudes. For private forests, younger people placed significantly less importance on wood products and significantly more on heritage than did the older generation. For public forests, the younger generation valued scenic beauty significantly higher than did the older generation. Younger people were significantly more likely than older people to believe we are spending too little to protect the environment, and that environmental laws have not gone far enough. Generally, younger people tend to have more bio-centric values of forests than older people. There were no significant correlations between length of residency in the South and values of public or private forests or environmental attitudes. Females exhibited significantly stronger pro-environmental attitudes than males, and were more likely than males to believe that we have spent too little on the environment; and to believe that environmental laws and regulations have not gone far enough.

Table 3-220. Percentage of local residents 16 or older indicating the stated management objective is important and percentage indicating extremely important by forest and region.

Management Objective	Jefferson NF (N=1403)	Southern Appalachian Region
Protect streams, lakes, and watershed areas	94.7/79.8	91.9/79.2
Protect wildlife habitats	91.8/75.0	89.9/72.7
Protect old growth forests	85.5/65.3	85.3/66.2
Habitat for wildlife and bird viewing	85.5/64.1	84.0/61.4
Open areas for wildlife	77.8/50.8	73.9/48.4
Allow cultural uses of forests	74.7/55.4	72.5/51.3
Use controlled fires	74.4/55.8	74.5/53.2
Trail systems for non-motorized recreation	71.2/39.7	68.7/39.5
Increase law enforcement	70.3/48.9	67.8/48.2
Restrict mineral removals	65.6/52.5	64.1/48.6
Designate more areas as wilderness	65.7/41.7	67.1/41.4
Allow diversity of uses such as grazing, recreation, and wildlife habitat	66.8/39.1	65.0/36.6
Increase acres in the National Forest	65.7/43.5	65.2/44.1
Make management decisions at the local level	65.3/40.6	63.8/37.1
Allow management activities near streams	60.2/35.2	60.9/35.5
Allow recreation fees that go back to management	58.0/34.1	58.6/32.9
Increase wildlife for hunting	52.2/31.5	46.6/27.8
Limit people who visit wilderness	47.4/25.7	48.0/26.2
Limit people on a river at one time	45.3/25.7	47.2/28.8
Trade public for private lands to eliminate in holdings or acquire natural areas	41.8/21.7	44.8/22.9
Expand commercial recreation services	37.3/20.3	36.3/20.2
Allow harvesting and mining to support communities	35.8/23.2	36.2/20.1
New paved roads for cars	31.2/19.7	34.5/20.0
Allow recreational gold prospecting and dredging	24.1/12.5	24.2/11.7
Expand access for motorized off-highway vehicles	23.7/13.5	22.8/13.1
Allow commercial leasing of oil and gas rights	21.5/14.8	19.7/11.6

Source: National Survey on Recreation and the Environment, Version 12, November 2001 to April 2002.

Uses of the Forest

Demand analyses were conducted for several resources areas and are discussed in other sections of the Plan and EIS.

Priorities for Management of Private Land by Non-Industrial Owners

The Assessment found that approximately 75% of the 37 million acres of the SAA region are privately owned. Of these 37 million acres approximately 19 million are forested acres.

SOCIAL AND ECONOMIC IMPACT ANALYSIS

Agriculture and timber harvesting are the overwhelming primary commodity uses of private undeveloped land. Recreation is the dominant non-commodity use. Raising livestock, recreation, enjoyment of a rural lifestyle, and having green space are most often listed as important reasons for owning land in the Southern Appalachians.

NIPF MANAGEMENT PRIORITIES

In the Journal of Forestry article “Changing Demographics, Values, and Attitudes”, H. Ken Cordell and Michael Tarrant, October/November 2002, pp. 28-33, found that privately owned land dominates in the South. Corporate private owners typically provide recreation access by leasing land to clubs, counties, or others. Individual owners usually have little to none of their land open, either through lease or other means (Teasley et al., 1999). Persistently, the number of southern owners allowing the public to recreate on their land has been decreasing (Cordell et al., 1999). Among individual owners approximately 59% indicate that an emphasis in managing their land is maintaining and improving the land’s natural components. For 37% of owners, improving the natural components is the primary thing they emphasize with their land. Accordingly, only about 14% of owners in the South permit the outside public to use their lands, even though the greatest growth in demand is for nature appreciation and photography. It appears that even less land may be open to public recreation in the future.

Unless conditions become more favorable for landowners, the percentage of them permitting public access is likely to continue to decrease, as it has been for several years. Increasingly, individuals and families are purchasing land for their own personal recreational pursuits and these owners are even less likely to permit others use of their land.

POTENTIAL CONFLICTS

A highly significant and growing issue nationally and in the South is that of conflict. Conflicts limit supply and increase the costs of management. Conflicts addressed in the SFRA included those between similar uses because of crowding; conflicts between non-similar uses because of incompatible norms, values and goals; and conflicts between users and providers.

Perhaps the most worrisome type of recreation conflict is that between users and owners of private tracts. These conflicts can and often do lead to posting and other ways of denying access, which act to limit supply. Because most of the forestland in the South is privately owned, conflicts between recreational users and private forestland owners are especially significant. Results from the 1995 National Private Landowner Survey, NPLOS 95 (Teasley et al., 1999), suggest a number of possibilities for owner-user conflict. For example, about 59% of individual southern landowners indicate that improving wildlife, water, aesthetics and other natural components of their land is an important emphasis in their land management. Because landowners sometimes encounter use problems they may perceive to be incompatible with their conservation goals, land closure can result. The more prominent of such problems include dumping garbage, littering, illegal hunting and fishing, damage to fences and gates, damage to roads, disturbance of wildlife, and careless shooting.

Not all, maybe not even most, of these problems are the result of recreation use, although owners perceive them to be. As of 1995, about 41% of owners in the South posted their land. Among owners who already post some or all of their land, 16% anticipate posting more in the future. Very few anticipate posting less. Increasing demands for off-road vehicle use, hunting, fishing, and other of the more consumptive recreational activities, are likely to bring about more recreation participant-land owner conflicts. In part as a response, many of the higher-income residents of the South are purchasing their own land for personal recreational pursuits. Very often these purchased lands end up being posted.

Direct, Indirect, and Cumulative Economic Effects

SOCIAL AND ECONOMIC IMPACT ANALYSIS

EFFECTS ON EMPLOYMENT AND INCOME

The management of the Jefferson National Forest has the potential to affect jobs and income 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 economic sectors. On the Forest, effects are based on changes in six major Forest-level outputs: the amount of timber volume and type of product to be harvested, payments to states (counties), Forest Service expenditures, recreation use, mining leases and grazing permits. For purposes of estimating the socio-economic impact, counties and cities that contain forest acreage 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 3-221 illustrates how the proposed alternatives differ from the current management direction (Alternative F) for potentially affecting jobs in the local economy. Employment changes from the current situation range from an estimated decrease of minimum decrease of 2% for Alternative D (the alternative with the highest level of commodities) to a maximum decrease of 14% for Alternative G within the first ten 10 of Forest Plan implementation. The minerals program has the greatest potential to affect jobs, followed by recreation the amount of money the Forest Service spends in the local economy. Timber-related jobs fluctuate the most between the alternatives as a result of the various levels of timber harvest. Employment impacts are divided into the major sectors of the Jefferson's economy in Table 3-222. For all alternatives, Mining, 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.

LABOR INCOME

Labor income for the first decade for each resource program expenditure is given by alternatives in Table 3-223. Impacts to the local economy sectors are shown in Table 3-224. The current direction alternative has $86 million of labor income associated with it. The range of labor income then ranges from $71 million for Alternative G to $84 million for Alternative D. The minerals program, Forest Service expenditures and the recreation and program consistently contribute the majority of labor income for all alternatives. All alternatives except for E and G also contribute a fair amount from the timber program.

REVENUES AND PAYMENTS

With the exception of Alternative D, Forest Service revenues from program activities, which result in payments to states (counties), are expected to decrease from the current direction for all proposed alternatives. The magnitude of payments to states expected in the first decade is shown in Table 3-225. From $11 million per decade currently, Alternative F would be expected to show a $2.7 million payment; Alternatives G and I a

Table 3-221. Employment by Program by Alternative (Average Annual, Decade 1, jobs)

Resource	Current Alt. F	Alt. A	Alt. B	Alt. D	Alt. E	Alt. G	Alt. I
Recreation	932	954	945	975	1,038	962	994
Wildlife and Fish	114	131	115	118	123	108	120
Grazing	1	1	0	1	1	0	1
Timber	287	252	210	467	83	40	259
Minerals	1,487	1,158	1,253	1,171	1,215	1,246	1,215
Payments to States/ Counties	12	11	9	18	4	3	8
Forest Service Expenditures	601	610	597	617	595	592	605
Total Forest Service Management	3,434	3,117	3,130	3,368	3,059	2,950	3,202
Percent Change from Current	---	-9.2%	-8.9%	-1.9%	-10.9%	-14.1%	-6.7%

Source: IMPLAN model

Table 3-222. Employment by Major Industry by Alternative (Average Annual, Decade 1, jobs)

Industry	Current Alt. F	Alt. A	Alt. B	Alt. D	Alt. E	Alt. G	Alt. I
Agriculture	40	40	38	43	39	35	41
Mining	926	730	786	739	766	782	765
Construction	136	111	116	119	109	109	114
Manufacturing	223	201	177	322	109	82	202
Transportation, Communication & Utilities	74	67	66	77	62	58	70
Wholesale Trade	80	75	73	86	70	65	78
Retail Trade	606	589	580	618	603	565	605
Finance, Insurance, & Real Estate	95	84	84	93	81	78	87
Services	688	657	646	703	656	615	675
Government (Federal, State & Local)	551	550	550	552	551	548	551
Miscellaneous	15	13	13	15	13	12	14
Total Forest Management	3,434	3,117	3,130	3,368	3,059	2,950	3,202
Percent Change from Current	---	-9.2%	-8.9%	-1.9%	-10.9%	-14.1%	-6.7%

Source: IMPLAN model

Table 3-223. Labor Income by Program by Alternative (Average Annual, Decade 1, million dollars)

Resource	Current Alt. F	Alt. A	Alt. B	Alt. D	Alt. E	Alt. G	Alt. I
Recreation	$19.0	$19.5	$19.3	$19.9	$21.2	$19.6	$20.3
Wildlife and Fish	$2.5	$2.9	$2.5	$2.6	$2.7	$2.4	$2.7
Grazing	$0.0	$0.0	$0.0	$0.0	$0.0	$0.0	$0.0
Timber	$7.8	$6.9	$5.7	$12.7	$2.3	$1.1	$7.2
Minerals	$46.7	$36.4	$39.4	$36.8	$38.2	$39.1	$38.2
Payments to States/Counties	$0.4	$0.3	$0.3	$0.6	$0.1	$0.1	$0.3
Forest Service Expenditures	$9.2	$10.1	$8.8	$10.9	$8.5	$8.1	$9.6
Total Forest Service Management	$85.6	$76.1	$76.0	$83.6	$73.0	$70.5	$78.1
Percent Change from Current	---	-11.1%	-11.2%	-2.3%	-14.7%	-17.7%	-8.7%

Source: IMPLAN model

Table 3-224. Labor Income by Major Industry by Alternative (Average Annual, Decade 1, millions of dollars)

Industry	Current Alt. F	Alt. A	Alt. B	Alt. D	Alt. E	Alt. G	Alt. I
Agriculture	$0.5	$0.5	$0.5	$0.5	$0.5	$0.4	$0.5
Mining	$31.0	$24.5	$26.4	$24.8	$25.7	$26.3	$25.7
Construction	$4.7	$3.8	$4.0	$4.1	$3.8	$3.8	$3.9
Manufacturing	$6.6	$6.0	$5.3	$9.3	$3.5	$2.7	$6.1
Transportation, Communication & Utilities	$2.9	$2.7	$2.6	$3.1	$2.5	$2.3	$2.8
Wholesale Trade	$3.1	$2.9	$2.8	$3.3	$2.7	$2.5	$3.0
Retail Trade	$10.3	$10.0	$9.8	$10.5	$10.2	$9.6	$10.3
Finance, Insurance, & Real Estate	$2.8	$2.5	$2.5	$2.8	$2.4	$2.3	$2.6
Services	$15.2	$14.2	$14.0	$15.4	$13.9	$13.1	$14.6
Government (Federal, State & Local)	$8.3	$8.9	$7.9	$9.6	$7.7	$7.3	$8.6
Miscellaneous	$0.2	$0.1	$0.1	$0.2	$0.1	$0.1	$0.1
Total Forest Management	$85.6	$76.1	$76.0	$83.6	$73.0	$70.5	$78.1
Percent Change from Current	---	-11.1%	-11.2%	-2.3%	-14.7%	-17.7%	-8.7%

Source: IMPLAN model

SOCIAL AND ECONOMIC IMPACT ANALYSIS

REVENUES AND PAYMENTS

PRESENT NET VALUE OF THE ALTERNATIVES

$1.4 million payment and $2.1 million payment, respectively, to the counties within the Jefferson NF boundaries.

Table 3-225. Forest Service Revenues and Payments (Average Annual, Decade 1, million dollars)

Resource	Current Alt. F	Alt. A	Alt. B	Alt. D	Alt. E	Alt. G	Alt. I
Recreation	$0.0	$0.0	$0.0	$0.0	$0.0	$0.0	$0.0
Wildlife and Fish	$0.0	$0.0	$0.0	$0.0	$0.0	$0.0	$0.0
Grazing	$0.0	$0.0	$0.0	$0.0	$0.0	$0.0	$0.0
Timber	$5.1	$4.6	$3.9	$8.2	$1.4	$0.7	$3.6
Minerals	$5.7	$4.6	$4.9	$4.6	$4.8	$4.9	$4.8
Soil, Water and Air	$0.0	$0.0	$0.0	$0.0	$0.0	$0.0	$0.0
Protections & Forest Health	$0.0	$0.0	$0.0	$0.0	$0.0	$0.0	$0.0
Total Revenues	$10.9	$9.3	$8.9	$12.9	$6.3	$5.7	$8.5
Payments to States/Counties	$2.7	$2.3	$2.2	$3.2	$1.6	$1.4	$2.1

Source: IMPLAN model

JEFFERSON NATIONAL FOREST'S CURRENT ROLE

Finally, Table 3-226 illustrates the percentage contribution of the Jefferson NF's current management program (Alternative F) to the area's economy. The Jefferson NF is associated with 1% of the total local economy's jobs, and 1% of the labor income. Mining, 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, where non-government owners could supply those entities the timber demanded in this local economy. Therefore, there would likely be no loss of jobs or income from a reduced federal timber program. Minerals play a significant part in the forest's contribution to the local economy, followed by recreation.

PRESENT NET VALUE OF THE ALTERNATIVES

Table 3-227 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 such as for timber, minerals, range, special uses, etc. Non-market values are estimated values for amenities such as wildlife and recreation. There are many values associated with National Forests that cannot be expressed in monetary terms. Many values are highly personal and subjective in nature. These, however, may be the greatest value of National Forests to the nation. 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 the National Forests. Although the Forest Service recognizes the validity and importance of these values, the existing literature is not sufficient to serve as

Table 3-226. Current Role of Forest Service-Related Contributions to the Area Economy

Industry	Employment (Jobs)	Employment (Jobs)	Labor Income ($ million)	Labor Income ($ million)
	Area Totals	FS-Related	Area Totals	FS-Related
Agriculture	20,752	40	$144.3	$0.5
Mining	11,424	926	$673.6	$31.0
Construction	34,997	136	$1,016.6	$4.7
Manufacturing	75,436	223	$2,723.4	$6.6
Transportation, Communication & Utilities	21,464	74	$846.1	$2.9
Wholesale Trade	21,184	80	$729.7	$3.1
Retail Trade	89,978	606	$1,491.4	$10.3
Finance, Insurance, & Real Estate	27,674	95	$809.0	$2.8
Services	126,045	688	$3,198.7	$15.2
Government (Federal, State & Local)	71,634	551	$2,275.5	$8.3
Miscellaneous	4,374	15	$40.4	$0.2
Total	504,962	3,434	$13,948.8	$85.6
Percent of Total	100.0%	0.7%	100.0%	0.8%

Source: IMPLAN model

a quantitative measure for some of these values, that are often geographically localized in nature. Therefore, passive use values for such things as wilderness and wildlife habitat must be taken into consideration in a qualitative sense. Because such values are not expressed in monetary terms and therefore not included in the economic efficiency analysis does not mean that they have been excluded from the determination of 'net public benefits.' When discussing the evaluation of Forest Plan alternatives, the regulations state that the evaluation 'shall compare present net value, social and economic impacts, outputs of goods and services, and overall protection and enhancement of environmental resources' [36 CFR 219.12(h)]. It is this process that results in a Forest Plan that 'maximizes long term net public benefits in a environmentally sound manner' [36 CFR 219.1]. 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 via 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. For resources that have no values estimated by generally accepted methods, we have chosen to discuss them in a narrative fashion as part of the assessment of net public benefits that is made in the Record of Decision for the Jefferson National Forest Plan.

The cumulative total present net values between all of the alternatives are fairly close together. Alternative G with the lowest PNV differs from Alternative A with the greatest PNV by less than 13%. Although some programs may change between alternatives, both the costs and benefits change at a proportional rate, making the net PNV more comparable.

SOCIAL AND ECONOMIC IMPACT ANALYSIS

PRESENT NET VALUE OF THE ALTERNATIVES

Table 3-227. Cumulative Decadal Present Net Values of Benefits and Costs (millions of dollars, 4% discount rate cumulative to midpoint of 5th decade)

	Alt. A	Alt. B	Alt. D	Alt. E	Alt. F	Alt. G	Alt. I
Present Value Benefits by Program:							
Range	$1	<1$	$1	$1	$1	$0	$1
Timber	$118	$103	$201	$35	$106	$17	$93
Minerals	$137	$148	$138	$142	$175	$146	$138
Recreation	$1,369	$1,208	$1,230	$1,361	$1,225	$1,282	$1,260
Wildlife	$1,219	$1,067	$1,094	$1,149	$1,060	$1,010	$1,116
Total Present Value Benefits	**$2,844**	**$2,528**	**$2,664**	**$2,688**	**$2,568**	**$2,454**	**$2,607**
Present Value Costs by Program:							
Range	$4	$2	$3	$3	$3	$0	$4
Timber	$78	$65	$132	$22	$71	$11	$62
Roads/Engineering	$40	$38	$36	$39	$36	$36	$39
Minerals	$7	$7	$7	$7	$7	$7	$7
Recreation	$68	$63	$57	$70	$57	$63	$66
Wildlife	$10	$13	$8	$10	$8	$14	$10
Soil, Water and Air	$6	$12	$5	$7	$5	$13	$6
Protection/Forest Health	$70	$71	$67	$69	$61	$70	$70
Lands	$9	$9	$8	$9	$8	$9	$9
Planning/Inventory/ Monitoring	$21	$21	$19	$21	$19	$21	$21
Total Present Value Costs	**$313**	**$300**	**$342**	**$257**	**$275**	**$243**	**$295**
Cumulative Total Present Net Value	**$2,531**	**$2,228**	**$2,322**	**$2,431**	**$2,293**	**$2,211**	**$2,312**

Direct, Indirect, and Cumulative Social Effects

Since the beginning of the Jefferson's planning process, numerous public meetings were held to allow people an opportunity to express their wants, needs and demands for access to and use of national forest resources. Many of these views were used to develop the range of alternatives considered in this analysis. Public meetings, however, typically represent only a portion of the public's interests and seldom represent the so-called 'silent majority' who do not or cannot attend meetings. Therefore, the Southern Region commissioned the Southern Research Station to undertake a telephone survey to randomly survey the public within a 75-mile radius of our national forests currently revising their Land and Resource Management Plans. This type of survey provides input from a broader public concerning what they would like to see emphasized in national forest management. For more information on how this survey was conducted, see the "Public Survey Report, Southern Appalachian National Forests, George Washington and Jefferson National Forests." The following section will attempt to relate the impacts of the alternatives on the major social issues identified from both public meetings and the survey.

GENERAL ATTITUDES AND VALUES

The public survey provided some information on the values residents have relating to natural resources. Well over 90% of the sample for the Jefferson National Forest market area thought protection of clean water was an important management goal. The next highest percentages (in the low 90's) were maintaining the forests in good condition for future generations, providing protection for wildlife and habitat, protecting trees for healthy forests, leaving forests natural in appearance, and protection of rare or endangered species.

Other values favored by survey participants included management of national forests as sources of raw materials and products to support local industries (38%), permitting of grazing by livestock (45%), helping local tourism businesses (58%), provisions of an abundant timber supply (70%) and outdoor recreation (77%). All of these values were highly consistent with priorities of residents throughout the Southern Appalachian region.

MANAGEMENT OBJECTIVES IMPORTANT IN MANAGEMENT OF NATIONAL FORESTS

Over 80% of the survey participants thought the top management objectives should include: protection of streams, lakes and watershed areas, protection of wildlife habitats, protection of old growth areas and provision of habitat for wildlife and bird viewing. Over 70% thought use of controlled fire was important, as well as provision of trail systems for non-motorized recreation. Over 60% thought more areas should be designated as wilderness and a diversity of uses such as grazing, recreation and wildlife habitat (in other areas) be allowed. On the lower end of the spectrum, the objectives from least to greater importance included: allowance of commercial leasing of oil and gas rights, expansion of access for motorized off-highway vehicles, provision of new paved roads for cars and allowance of harvesting and mining to support communities. The priority for these objectives was nearly the same as the average for the entire Southern Appalachian region.

People who reside in areas near the Jefferson generally put ecosystems, wildlife and naturalness above utilitarian objectives in national forest management. However, as previously shown in the Economic Impacts section, commodities such as mining and timber can contribute important portions of income and employment to the local economy. Therefore, impacts to the ‘naturalness’ aspect of the forest are compared with impacts to the ‘commodity’ aspect of the forest.

NATURALNESS IMPACTS

Naturalness includes the protection of the natural qualities of the forest, such as clean water, wildlife habitat, healthy trees, and old growth.

The continuum in the forest planning alternatives from more management activities and provision of multiple-use, to that of fewer management activities is as follows:

More Management Activities….Fewer Management Activities

D F A I B E G

Alternative D calls for water quality and riparian areas to be protected through BMP’s. Alternative A would restore degraded watersheds and emphasize improvement of aquatic habitats and water quality. Alternative I provides resilient and stable conditions to ensure the quality and quantity of water necessary to support beneficial water uses. Alternative B calls for riparian ecosystems to be managed to maintain water quality. Degraded conditions would be restored. Alternative E provides for riparian ecosystems and streamside management zones to provide water-quality protection and improvement. Alternative G provides for riparian area protection and restoration through emphasis on watershed assessments and establishment of riparian conservation areas. All alternatives therefore make some kind of provision for addressing clean water.

Alternative D would have the least emphasis of all alternatives on “naturalness” Forests would appear highly variable in tree sizes and openings and the canopy may be seen from roadways and vista points. It would provide old growth only on unsuitable lands already withdrawn from the timber base. would be recommended for wilderness. Alternative A provides high quality scenery in both a natural and managed settings. Highways and roads in the forests would have forest stands with few, if any, broken views to support enhancements to tourism. Roadless areas adjacent or in close proximity to wilderness areas would be recommended for wilderness designation. Alternative I provides for a healthy forest by managing ecosystems through restoration or maintenance to provide for designed species composition (species mix), structure (age class distribution), function (resulting benefits), and productivity over time. A variety of large, medium and small old growth patches will be managed (through restoration, protection, or maintenance) to meet biological and social needs. Alternative B would emphasize the natural processes in a natural landscape pattern. Restoration activities could produce both large and small openings. Alternative E supports visual quality and most areas would maintain a forested canopy. A substantial amount of the forest would be allocated to providing old growth for biological and aesthetic settings. Many insect and disease impacts would be tolerated as part of a functioning natural ecosystem. Most wild and scenic rivers would be recommended for adding to the National Wild and Scenic Rivers System. Alternative G would provide for most roadless areas to be recommended for wilderness. Emphasis would be on establishing a naturally resilient forest that would avoid large outbreaks of forest pests. Road network mileage would be reduced through closure of roads not needed for stewardship or restoration.

COMMODITY IMPACTS

Commodity impacts include timber production, extraction of minerals and livestock grazing. Alternative D emphasizes a balanced age class. All lands considered suitable for sustained-yield timber management would be available for sustained-yield management. Each major forest group---pine, mixed, and hardwood---would have specific target rotation ages. Alternative A provides sustained yield of wood products with an emphasis on high quality sawtimber. Alternative I allows forest management activities where needed and appropriate to achieve the desired composition, structure, function of forest ecosystems. A result of such activities will also be to provide a sustainable supply of wood products. Alternative B emphasizes restoring natural resources. Wood products would be managed in concert with restoration and creating wildlife habitats. Timber sales would be a by-product of restoration management. Alternative E provides for the overall long-term timber product objective of large-diameter and high quality sawtimber species. Alternative G emphasizes large undisturbed areas. High quality timber would be produced in long rotations in areas outside sensitive species habitat.

Recreation uses as a forest management objective were thought as important by about two thirds of our respondents. The management objective to allow a diversity of uses such as grazing, recreation and wildlife habitat had 66% positive response. Allowing recreation fees that go back to the forest were favored by about 60%.

Alternative D provides for developed and dispersed recreation opportunities in both natural and managed settings. Potential for roaded natural experiences would increase as access roads for timber harvests are built or improved. Semi-primitive experiences would be designated for unsuited lands. Alternative A emphasizes developed and dispersed recreation opportunities achieved by commercial recreation and increased public access. Public access would be increased in high-use areas in order to provide more recreation opportunities. Alternative I provides a spectrum of high quality, nature-based recreation settings and opportunities which are not widely available on non-federal lands. Hiking, biking, equestrian trail systems are emphasized in non-motorized settings with high quality landscapes. OHV routes are designated in proper settings. Hunting, fishing, and non-consumptive wildlife opportunities are also emphasized. Backcountry recreation experiences are also provided. Alternative B provides a variety of recreating settings in areas where they would be compatible with restoration activities. A wide variety of recreation activities would be provided. Alternative E emphasizes settings that would attract a variety of recreation users. Active resource management would be concentrated in certain locations that support recreation use and visual quality. Dispersed and developed recreation areas and opportunities would be increased. A variety of recreation experiences including concentrated use of off-highway vehicle use is provided. Alternative G emphasizes backcountry and nature-oriented non-motorized recreation opportunities; semi-primitive, wildlife, and nature-oriented recreation opportunities would be provided. Developed facilities would occur where they do not detract from ecosystem function and landscape connectivity.

RECREATIONAL IMPACTS

One of the ways people relate to the National Forests is their recreational use of National Forest lands. For more information on the types of recreational activities people are involved with on the National Forest, and how this may change by alternative, see the section in this EIS on Dispersed and Developed Recreation.

ENVIRONMENTAL JUSTICE

A specific consideration of equity and fairness in resource decision-making is encompassed in the issues of environmental justice and civil rights. Executive Order 12898, "Federal Actions to Address Environmental Justice in Minority Populations and Low-Income Populations," provides that "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 makes clear that its provisions also apply fully to programs involving Native Americans. 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 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, churches, libraries, non-profit organizations, civic associations, industries, academia, and other types of organizations. Participation was sought in various locations and formats throughout the planning area. Chapter 5 of the EIS lists the entities to whom either summaries of, or entire documents of, the Draft EIS and Draft Plan were mailed for comment. This list includes numerous Native American, minority and low-income representatives.

2. Determining the Affected Environment – The Social and Economic Impact Analysis section of Chapter 3 of the EIS presented information related to population growth, minority populations, population density, income, unemployment and poverty, households, and economic diversity in the area directly affected by Jefferson National

Forest 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, with the exception of the cities of Roanoke and Bedford. However, the area of extreme southwest Virginia of the Clinch Ranger District does represent a population where there has been continued high poverty and unemployment rates, negative population growth, and depressed housing values. Therefore for the purpose of evaluating environmental justice, this area of the Clinch District has been recognized as a 'low-income' population.

3. Analysis of Effects – Chapter 3 of the EIS, the Affected Environment and Effects portion of the land management planning process, discusses in more detail the estimated effects for each alternative if implemented on the Clinch District. Management actions that have the greatest potential for impacting human health are those that may influence air quality and water quality. However, there are no disproportionately adverse environmental or health effects to the low-income populations on the Clinch District, based on the programmatic decisions and land allocations within the Jefferson National Forest's Plan and EIS.

Air Quality

The Clinch District is mostly affected by air current patterns from Tennessee and North Carolina. EPA monitoring of fine particulate matter (which contribute to respiratory health problems) has shown that the Bristol area annual average based on three years data may have exceeded the $PM_{2.5}$ standard. There is a likelihood that the Johnson City-Kingsport-Bristol metropolitan statistical area will be designated as a non-attainment area for fine particles and ozone. With this designation, a state implementation plan will be designed to bring the area back into attainment. This would greatly improve air quality in this area over the long-term. Prescribed fire emissions is one way national forest management can directly impact air quality. Fine particles make up 70% of the emissions from prescribed fire. However, there are standards that require a smoke management plan and specific climatic burning conditions for prescribed fire. Smoke-sensitive targets are identified before burning that include human health and terrestrial species concerns. Standards related to smoke management and monitoring should keep particulate matter contributions from prescribed fire to a minimum. Nitrogen oxide emissions and volatile organic compound emissions (which contribute to ozone formation) are associated with the construction phase and production phase of oil and gas development. However, Table 3-191 shows that the maximum additional contribution of nitrogen oxides from future oil and gas well construction on the Jefferson as 1% and contributions of volatile organic compounds from future production on the Jefferson as 5%. Minor new activity is anticipated for other federal leasable minerals over the next 15 years. Therefore, management activities should not significantly affect human health on populations around the Clinch Ranger District.

Water Quality

Oil and gas well development has the potential to affect groundwater quality. However, effects on groundwater are expected to the small due to the extensive review and approval process of drilling plans and surface use plans. Inspection and enforcement are done to ensure compliance with the plans. There is the potential to affect karst areas that would lead to groundwater pollution but there are several standards in place to protect karst areas, including 200 foot buffers. Standards are also in place to provide for a geologic investigation of potential landslide hazards as part of the siting, design and maintenance of roads and other related gas well activities. Table 3-190 of the EIS shows the Reasonably Foreseeable Development Scenario for oil and gas wells on the Jefferson for each alternative and for each 5th level watershed on the Clinch District. The physical impacts from oil and gas development are erosion and sedimentation. Table 3-194 displays the cumulative impact on watershed health from all activities that could contribute to sedimentation in the Clinch watersheds for each alternative. There is expected to be no change in the watershed health index from the current situation for any of the alternatives.

4. Alternatives – Although there is a low-income population area identified on the Clinch District, there are no management activities planned where the effects on human health are considered significant. Therefore, there was no need to develop alternatives 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 of 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.

OTHER EFFECTS

Relationship Of Short-Term Use And Long-Term Productivity

The relationship between the short-term uses of the environment and the maintenance and enhancement of long-term productivity is complex. Short-term uses are generally those that occur irregularly on parts of the Forest, such as prescribed burning. Long-term refers to a period greater than ten years.

Productivity is the capability of the land to provide market and amenity outputs and values for future generations. Soil and water are the primary factors of productivity and represent the relationship between short-term uses and long-term productivity. The quality of life for future generations would be determined by the capability of the land to maintain its productivity. By law, the Forest Service must ensure that land allocations and permitted activities do not significantly impair the long-term productivity of the land.

The alternatives considered in detail, including the preferred alternative, incorporate the concept of sustained yield of resource outputs while maintaining the productivity of all resources. The specific direction and mitigation measures included in the forest-wide management standards ensure that long-term productivity would not be impaired by the application of short-term management practices.

Each alternative in the Forest Plan was analyzed using the SPECTRUM linear programming model (See Appendix B – Description of the Analysis Process), to ensure that the minimum standards could be met. The alternative was changed if some aspect did not meet any of the minimum standards. Through this analysis, long-term productivity of the Forest's ecosystems is assured for all alternatives.

As stated earlier, the effects of short-term or long-term uses are extremely complex, and depend on management objectives and the resources that are emphasized. No alternative would be detrimental to the long-range productivity of the Jefferson National Forest.

The management prescriptions and the effects of implementing the revised Forest Plan will be monitored. Evaluation of the data collected will determine if standards for long-term productivity are being met, or if management practices need to be adjusted. Monitoring requirements and standards apply to all alternatives, and are included in Chapter 5 of the revised Forest Plan.

Irreversible And Irretrievable Commitment Of Resources

Irreversible and irretrievable commitments of resources are normally not made at the programmatic level of a Forest Plan. Irreversible commitments are decisions affecting non-renewable resources such as soils, minerals, plant and animal species, and cultural resources. Such commitments of resources are considered irreversible because the resource has been destroyed or removed, or the resource has deteriorated to the point that renewal can occur only over a long period of time or at a great expense. While a Forest Plan can indicate the potential for such commitments, the actual commitment to develop, use, or affect non-renewable resources is normally made at the project level.

Irretrievable commitments represent resource uses or production opportunities, which are foregone or cannot be realized during the planning period. These decisions are reversible, but the production opportunities foregone are irretrievable. An example of such commitments is the allocation of management prescriptions that do not allow timber harvests in areas containing suitable and accessible timber lands. For the period of time during which such allocations are made, the opportunity to produce timber from those areas is foregone, thus irretrievable.

In the case of the Federal oil and gas leasing discussed in the minerals section of this Chapter, actual extraction of oil and gas would be considered an irreversible commitment, since this is a non-renewable resource. However, the decision to actually permit this extraction will occur following receipt of an Application for Permit to Drill, therefore the consent to lease decision is not an irreversible commitment. On the other hand, a decision not to consent to issue a Federal oil and gas lease in a particular area is an irretrievable commitment because the production opportunities are foregone for this planning period.

Effect On Wetlands And Floodplains

No significant adverse impacts on wetlands or floodplains are anticipated. Wetlands values and functions would be protected in all alternatives through the implementation of the Riparian Management Prescription and following Virginia's Best Management Practices for Forestry. Under the requirements of Executive Order 11990 and Clean Water Act, Section 404, wetland protection would be provided by ensuring that new construction of roads and other facilities would not have an adverse effect on sensitive aquatic habitat or wetland functions. In addition, wetland evaluation would be required before land exchanges or issuance of special-use permits in areas where conflicts with wetland ecosystems may occur.

Mitigation measures have been designed to conserve riparian areas and protect floodplains through the Riparian Management Prescription. The direction of this prescription is embedded in all management prescriptions. Executive Order 11988 also requires site-specific analysis of floodplain values and functions for any project occurring within the 100-year floodplain zone, and prior to any land exchange involving these areas.

Protective measures for riparian areas include the delineation of riparian corridors on perennial and intermittent streams. Management activities within the riparian corridor must comply with the previously mentioned State BMPs and other State water quality regulations. Floodplains would be managed by locating critical facilities outside of floodplains or by using structural mitigation measures. Further protections are provided in forest-wide standards for management of ephemeral stream zones.

Unavailable Or Incomplete Information

The Jefferson National Forest 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 will always 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)*). Incomplete or unavailable information is noted in this chapter for each resource, where applicable.

Forest Plan monitoring is designed to evaluate assumptions and predicted effects. Should new information become available, the need to change management direction or amend the Forest Plan would be determined through the monitoring and evaluation process.

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CHAPTER 4

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Rappahannock American Indian Dancers
History Of Mattaponi Tribe
Mattaponi Red Thunder Drummers
Rising Water Dancers/Falling Water Drummers
Chickahominy Tribal Dancers
Tip Of The Feather-Pow Wow List
The Pepper Bird Foundation

ORGANIZATIONS

American Chestnut Cooperators Foundation
American Fisheries Society
American Forest & Paper Association
Appalachian Forest Management Group, including several different Chapters
Appalachian Hardwood Manufacturers
Appalachian Mountain Riders
Appalachian Trail Club Mount Rogers
Appalachian Trail Club Natural Bridge
Appalachian Trail Club Piedmont Area (PATH)
Appalachian Trail Club Roanoke
Appalachian Trail Club Tennessee Eastman
Arcs Inc
Asian Pacific Market
ATV Connection
Blacksburg Saddle Club
Blue Ridge Environmental Network
Blue Ridge Independent Living Center
Blue Ridge River Runners
Boy Scouts of America, Blue Ridge Mountain Council
Carolina Hispanic Association
Chattooga River Watershed Coalition
Citizens For Southwest Virginia
Citizens Organized to Protect the Environment

ORGANIZATIONS

Citizens Task Force
Clinch Powell Sustainable Development
Comite Hispano De Virginia
Common Ground
Craig County Horsemen
Craig Wildlife Association
Citizens for Jobs and the Environment
Devil's Fork Trail Club
Float Fisherman Of Virginia
Four Plus 4wd Club
Harrison Museum Of African American Culture
Health & Environment Action
Heartwood
High Riders 4wd Club
High Street Baptist Church
Hired Hands & Associates, Inc
Hispanos Unidos, Inc.
International Mountain Biking Association
Iron Mountain Trail Riders Club
Kanawha Trail Club
Maple Street Baptist Church
Mi Gente
Mountain Heritage Alliance
Mountain View ATV Riding Club
Mt Rogers Interpretive Association
National Association for the Advancement of Colored People, Roanoke Branch
National Committee For New River
National Off Highway Vehicle Conservation Council
National Wildlife Federation
Natural Resource Defense Council
Nature Conservancy, including several different Chapters
New River Valley Butterfly Group
New River Valley Environmental Coalition
New River Wildlife Club
North American Trail Riders Conference
Northern Virginia Trail Riders
Pacific Rivers
Piedmont Environmental Council
Pocahontas Development Group
Pulaski Sportsman's Club
Roanoke Preservation League
Roanoke Sister Cities
Roanoke Tribune
Roanoke Valley Bird Club
Roanoke Valley History Society

Ruffed Grouse Society, including several different Chapters
Science Museum Of Western Virginia
Settlers Museum Of Southwest Virginia
Sierra Club, including several different Chapters
Society of American Foresters
Southeast Lumber Manufacturers Association
Southern Appalachian Biodiversity Project
Southern Appalachian Forest Coalition
Southern Appalachian Multiple-Use Council
Southern Appalachian Native Forest Network
SouthPAW
Southwest Virginia Community Development Foundation
Southwest Virginia Museum
Spanish Club
St Gerard Catholic Church
SW Virginia Hang Gliding Association
SWVA 4wd Club
The Catholic Comm Of Blessed Sacrament
The Wilderness Society
The Wildlife Society Virginia
Tidewater 4 Wheelers
Trout Unlimited, including several different Chapters
United 4wd Association
Valley Podiatry
Virginia 4-Wheel Drive Association
Virginia Arabian Horse Association
Virginia Center For Coal & Energy Resources
Virginia Coal Council
Virginia Creeper Trail Club
Virginia Deer Hunters Association
Virginia Dept For Visually Handicapped
Virginia Federation of Garden Clubs
Virginia Forestry Association
Virginia Horse Council
Virginia Mining Association, Inc
Virginia Native Plant Society, including several different Chapters
Virginia Save Our Streams
Virginia Skyline Girl Scout Council
Virginia Snowmobile Association
Virginia Water Resources Research Center
Virginia Wildlife Federation
Walker Mountain Hunting Club
West Virginia Wildlife Federation
Western North Carolina Alliance
Wilburn Ridge Pony Association

Wild Turkey Federation including several different Chapters
Wildlife Management Institute
Woodrow Wilson Rehabilitation Center
WVA Scenic Trails Association
Wythe Bowhunters
Wythe Conservation Group

BUSINESS / INDUSTRY

Allegheny Power
American Electric Power
American Leisure
American Resources Group
APG Lime Corporation
Bennett Lumber
Blue Ridge Outdoors
Clinchfield Coal Company
Coastal Oil & Gas Corporation
Columbia Carolina Corporation
Columbia Gas Of Virginia, Inc
Columbia Natural Resources
Dixon Lumber Company, Inc
Ecology Center
Edwards & Harding Petrol Company
Equitable Production Company
Equitable Resources Corporation
Foresters Incorporated
Georgia Pacific
Johnson City Industrial Commission
Kingsport Power Company
L & E Lumber
Louisiana Pacific
Mid-Atlantic Lumber
Mountain City Lumber Company
Nuttall Estate
Osborne Lumber Company
Powell Valley Electric Cooperative
Ross Dockery Logging
Rye Valley Lumber Company
Scott County Outdoorsman, Ltd
Southern Environmental Law Center
Stone Container Corporation
Trust For Appalachian Trail Lands
Two Bros Logging Corporation
United Coal Company

Virginia Coal Association
Virginia Electric & Power Company
Virginia Forest Products, Inc
Virginia Gas Company
Virginia Leadership Development Promotion
Virginia Tourism Corporation
W R Deacon & Sons Timber, Inc
Western Virginia Land Trust
Westvaco Corporation Center
Westvaco Timberlands Division
WildLaw
Willamette Industries

LIBRARIES

Appalachian Collection Belk Library
Bedford Public Library
Blacksburg Public Library
Bluefield Public Library
Buchanan Branch Library
Buchanan County Public Library
Buena Vista Branch Library
C. Bascom Slemp Memorial Library
Carrier Library, JMU
Carroll County Public Library
Charles P Jones Memorial Library
Christiansburg Public Library
Coeburn Community Library
Damascus Public Library
Floyd Public Library
Franklin County Library
Galax-Carroll Regional Library
Haysi Public Library
Jane Caldwell Kelly Library
Jefferson-Madison Regional Library
John Cook Wyllie UVA-Wise Library
Jonnie B Deel Memorial Library
Lee County Public Library
Lonesome Pine Regional Library
Mcconnell Radford Univ Library
Montgomery-Floyd Regional Library
Narrows Public Library
Pearisburg Public Library
Pulaski County Library
Radford Public Library

LIBRARIES

REGIONAL / LOCAL GOVERNMENT ENTITIES

Richmond Public Library
Roanoke County Public Library
Rockbridge Regional Library
Salem Public Library
Scott County Public Library
Smyth-Bland Regional Library
St Paul Bicentennial Library
Tazewell County Public Library
USDA National Agricultural Library
University of VA Library
Virginia State Library
VPI & SU University Library
Washington County Public Library
Wise County Public Library
Wythe-Grayson Regional Library

REGIONAL / LOCAL GOVERNMENT ENTITIES

Appalachia Town Manager
Athens Mayor
Bedford County Board Of Supervisors
Big Stone Gap Manager
Blacksburg Dept Of Parks & Recreation
Bland County Administrator's Office
Bland County Board Of Supervisors
Botetourt County Administrator
Botetourt County Board Of Supervisors
Buchanan County Board Of Supervisors
Carroll County Board Of Supervisors
Carroll County Administrator
Clintwood Town Mayor
Coeburn Town Manager
Craig County Administrator
Craig County Board Of Supervisors
Craig County Extension
Damascus Town Council
Damascus Town Mayor
Dickenson County Board Of Supervisors
Duffield Town Mayor
Gate City Manager
Giles County Board Of Supervisors
Giles County Extension Service
Glen Lynn Mayor
Grayson County Administrator
Grayson County Board Of Supervisors

Grayson County Tax Assessor
Hinton Mayor
Independence Town Mayor
Lee County Administrator
Lee County Board Of Supervisors
Lee County Chamber Of Commerce
Letcher County Magistrates
Mercer County Commission
Monroe County Commission
Monroe County Farm Bureau
Montgomery County Board Of Supervisors
Montgomery County Planning Department
Narrows
Narrows Mayor
Norton City Manager
Norton Mayor
Pearisburg Town Manager
Pennington Gap Mayor
Pike County Magistrates
Pound Town Vice-Mayor
Pulaski
Pulaski Board Of Supervisors
Pulaski County Administrator
Pulaski County Chamber Of Commerce
Roanoke City Economic Development
Roanoke City Manager
Roanoke County Asst Administrator
Roanoke County Board Of Supervisors
Roanoke County Development
Rockbridge County Board Of Supervisors
Salem City Manager
Scott County Administrator
Scott County Chamber Of Commerce
Scott County Industrial Development Authority
Smyth County Administrator
Smyth County Board Of Supervisors
Smyth County Dept Of Commerce Development
Smyth County Chamber Of Commerce
St Paul Town Manager
Tazewell City Board Of Supervisors-Chair
Tazewell County Administrator
Tazewell County Board Of Supervisors
Town Of Blacksburg
Union Mayor
Vinton

REGIONAL / LOCAL GOVERNMENT ENTITIES

STATE GOVERNMENT AGEENCIES

Washington County Administrator
Washington County Board Of Supervisors
Washington County Chamber Of Commerce
Wise County Board Of Supervisors
Wise Town Manager
Wythe County Administrator
Wythe County Board Of Supervisors
Wytheville Town Mayor

STATE GOVERNMENT AGENCIES

Breaks Interstate Park
Natural Tunnel State Park
North Fork Of Pound Reservoir
Shot Tower State Park
Virginia Cave Board
Virginia Department Of Conservation And Recreation
Virginia Department Of Conservation And Recreation Conservation Economic Development
Virginia Department Of Conservation And Recreation Natural Heritage
Virginia Department Of Conservation And Recreation Outdoors Foundation
Virginia Department Of Conservation And Recreation Parks & Recreation
Virginia Department Of Conservation And Recreation Planning & Recreation Resources
Virginia Department Of Conservation And Recreation Tourism
Virginia Department Of Environmental Quality
Virginia Department Of Game And Inland Fisheries
Virginia Department Of Historic Resources
Virginia Department Of Transportation
Virginia Dept Mines/Minerals/Energy
Virginia Dept Of Agriculture & Consumer Services
Virginia Dept Of Forestry
Virginia Div Of Mined Land Reclamation
Virginia Div Of Mineral Resources
Virginia Division Of Tourism & Parks
Virginia Historical Preservation Office
Virginia Natural Resources Commission
Virginia Oil & Gas Inspector
Virginia Policy & Planning Manager
Virginia Route Transp Land Acq
Virginia Sec Of Economic Development
Virginia Sec Of Natural Resources
Virginia Sec Of Transportation
Virginia State Police
VPI & SU Cooperative Extension
West Virginia Department Of Agriculture (Forestry Division)
West Virginia Department Of Natural Resources

West Virginia Department Of Natural Resources, Environmental Protection
West Virginia Department Of Natural Resources, Wildlife Resources Division
West Virginia Wild Rivers Coord, Division Of Water

FEDERAL GOVERNMENT AGENCIES

Advisory Council on Historic Preservation
American Bird Conservancy
SAMAB-Uplands Res Lab
TVA
TVA NEPA Administration
US DOC National Marine Fisheries Service, NE Region
US DOD Great Lakes & Ohio Division
US DOE, Office of Environmental Compliance
US EPA Region III
US EPA, Office of Federal Activities
US FAA Eastern Region
US Federal Railroad Administration, Environmental Div P-14
US FHA Eastern Region
US ICC Energy and Environment
USCG Marine Environmental & Protection Division
USDA APHIS PPD/EAD
USDA APHIS, Animal Damage Control
USDA Flatwoods Job Corps
USDA FOREST SERVICE - Forest Protection
USDA FOREST SERVICE - Southern Region
USDA Monongahela NF
USDA NF Chattahoochee & Oconee
USDA NF Cherokee
USDA NF Clinch RD
USDA NF Daniel Boone
USDA NF FM & Sumter
USDA NF Glenwood RD
USDA NF in Alabama
USDA NF in North Carolina
USDA NF Mount Rogers NRA
USDA NF New Castle RD
USDA NF New River Valley RD
USDA NRCS
USDA Office of Civil Rights
USDA Rural Utilities Service
USDA Soil Conservation Service
USDA-REA-NEAE
USDI BLM Eastern States Office
USDI Environmental Policy & Compliance

FEDERAL GOVERNMENT AGENCIES

ELECTED OFFICIALS

USDI Fish & Wildlife Service
USDI NPS
USDI NPS, Appalachian Trail Conference
USDI NPS, Shenandoah National Park
USDI NPS, New River Gorge National River
USDI NPS, Northeast Region
USDI Office of Environmental Policy & Compliance

ELECTED OFFICIALS

Honorable A Victor Thomas
Honorable Ancel Smith
Honorable Anita Skeen Caldwell
Honorable Bob Wise
Honorable Charles Carrico, Sr
Honorable Clarence E Phillips
Honorable Daniel W Marshall, Iii
Honorable David A Nutter
Honorable Emmett W Hanger Jr
Honorable George Allen
Honorable Gerald Crosier
Honorable H. Morgan Griffith
Honorable Harold Rogers
Honorable Howard Cornett
Honorable Jackie T Stump
Honorable James M Shuler
Honorable Jay O'Brien
Honorable Jesse O. Guills
Honorable John Rockefeller
Honorable John S Edwards
Honorable John Warner
Honorable Johnny Ray Turner
Honorable Joseph Johnson, Jr
Honorable Lacey E Putney
Honorable Malfourd W Trumbo
Honorable Mark Warner
Honorable Mitch McConnell
Honorable Nick Rahall II
Honorable Paul Patton
Honorable Phillip P Puckett
Honorable Ray S. Jones, II
Honorable Rick Boucher
Honorable Robert Byrd
Honorable Robert Goodlatte
Honorable Robert Hurt
Honorable Stephen D Newman
Honorable Terry G Kilgore
Honorable Virgil Goode Jr
Honorable W. Benny Keister
Honorable W. Keith Hall
Honorable William C Wampler Jr

GLOSSARY

CHAPTER 6

ACRONYMS

AA - analysis area

ADA - Americans with Disabilities Act

AMS - Analysis of the Management Situation

APHIS - Animal and Plant Health Inspection Service

ARPA—Archaeological Resources Protection Act

ASQ - allowable sale quantity

AT - Appalachian Trail

ATV - all-terrain vehicle

AUM - animal unit month

BA - basal area; Biological Assessment

BE—Biological Evaluation

BEA—Bureau of Economic Analysis

BF - board foot

BMP - best management practice

BO—Biological Opinion

BSS - base sale schedule

CAA - Clean Air Act

CCF - hundred cubic feet

CE—categorical exclusion

CEQ - Council on Environmental Quality

CF - cubic foot

CFR - Code of Federal Regulations

CFS - cubic feet per second

CIP - Capital Investment Program

CISC - Continuous Inventory of Stand Conditions

CMAI - culmination of mean annual increment

CVH - cove hardwood.

CWA - Clean Water Act

DBH - diameter at breast height

DBRU - Drainage Basin Response Unit

DEIS - Draft Environmental Impact Statement

DFC - desired future condition

EA - Environmental Assessment

EAM—even-aged management

ECOMAP - Ecological Classification and Mapping Task Team

ECS - Ecological Classification System

EIS - Environmental Impact Statement

EMU - ecological management unit

EPA - Environmental Protection Agency

ESA - Endangered Species Act

EWPP- Emergency Watershed Protection Plan

FDR - forest development road

ACRONYMS

FRP - Forest Road Program

FEIS - Final Environmental Impact Statement

FH - Forest Highway

FIA - Forest Inventory and Analysis

FMAP - Fire Management Action Plan

FONSI—Finding of No Significant Impact

FR - Forest Road

FSH - Forest Service Handbook

FSM - Forest Service Manual

FTE - full-time employee

FY - fiscal year

GAO - Government Accounting Office

GIS - Geographic Information System

GDP - gross domestic product

GWNF - George Washington National Forest

GWJNF - George Washington & Jefferson National Forests

HRP - Human Resource Program

HUC - Hydrologic Unit Code

IDT - Interdisciplinary Team

IMPLAN—Impact Analysis for Planning

INFRA—Infrastructure

IPM - integrated pest management

IS - Interpretive Services

JNF—Jefferson National Forest

LAC—Limits of acceptable change

LAR - Land Area Report

LE - law enforcement

LOAP - Landownership Adjustment Plan

LRMP - Land and Resource Management Plan

LTA - landtype association

LTP - landtype phase

LTSYC - long-term sustained-yield capacity

LUG - land-use group

L&WCF - Land and Water Conservation Fund

LWD - large woody debris

M - thousand

M$ - thousands of dollars

M&E—monitoring and evaluation

MA - management area

MAI - mean annual increment

MAR - Management Attainment Report

MAUM - thousand animal unit month

MBF - thousand board feet

MCF - thousand cubic feet

MIL - management intensity level

MIS - management indicator species

MM - million

MM$ - millions of dollars

MMBF - million board feet

MMCF - million cubic feet

MMR - minimum management requirement

MMRVD - million recreation visitor-days

MOU - memorandum of understanding

MRVD - thousand recreation visitor-day

MWFUD - thousand wildlife and fish user-day

NAAQS - National Ambient Air Quality Standards

NAPAP - National Acid Precipitation Assessment Program

NEPA - National Environmental Policy Act

NF - National Forest

NFMA - National Forest Management Act

NFRS - National Forest Recreation Survey

NFS - National Forest System

NFSR - National Forest System Road

NHPA—National Historic Preservation Act

NLFCA - National Listing of Fish Consumption Advisories

NOI—Notice of Intent

NPL - National Priorities List

NPS - National Parks Service

NRCS - Natural Resources Conservation Service

NRIS - Natural Resource Information System

NTMB - neotropical migratory birds

NVUM - National Visitor Use Monitoring

NWPS - National Wilderness Preservation System

OHV - off-highway vehicle

OMP - operation maintenance and protection

ORV - off-road vehicle

PAOT - persons-at-one-time

PILT—Payment in Lieu of Taxes

PL - public law

PM - particulate matter

PNV - present net value

PNW - present net worth

PSD - prevention of significant deterioration

PSI - pounds per square inch

RAP - Roads Analysis Process or Procedure

RARE - Roadless Area Review and Evaluation

RARE II - the second Roadless Area Review and Evaluation

RBP - Rapid Bioassessment Protocol

RD - Ranger District

RLRMP - Revised Land and Resource Management Plan

RMO - Road Management Objectives

RNA - research natural area

RN - roaded natural

ROD - record of decision

ROS - Recreation Opportunity Spectrum

ROW - right-of-way

RPA - Resources Planning Act

RVD - recreation visitor-day

SAA - Southern Appalachian Assessment

SCORP - State Comprehensive Outdoor Recreation Plan

S&G - standard and guideline

ACRONYMS

SOURCES OF DEFINITIONS

SH - state highway

SHPO—State Historic Preservation Officer

SIC—Standard Industrial Code

SIO - Scenic Integrity Objective

SIP - State Implementation Plan

SMS - Scenery Management System

SPB - southern pine beetle

SP2 - semiprimitive 2

SPM - semi-primitive motorized

SPNM - semi-primitive non-motorized

SMZ - Streamside Management Zone

SYP—southern yellow pine

T&E - threatened and endangered species

T/E/S - threatened, endangered, and sensitive species

TESLR - threatened, endangered, sensitive, and locally rare species

TNC - The Nature Conservancy

TSI - timber stand improvement

TSP – total sale program

TSPIRS - Timber Sale Program Information Reporting System

TVA - Tennessee Valley Authority

UPH - upland hardwood/mixed

USC - United States Code

USDA - U.S. Department of Agriculture

USDI - U.S. Department of Interior

USFWS - U.S. Fish and Wildlife Service

USGS - U.S. Geological Survey

VMS - Visual Management System

VMEIS—Vegetation Management Environmental Impact Statement

VQO - visual quality objective

W&SR—Wild and Scenic River

WFUD - wildlife and fish user-day

WIN - Watershed Improvement Inventory

WO - Washington Office

WPN - white pine

WRP - Wetlands Reserve Program

WSA - wilderness study area

YPN - yellow pine

SOURCES OF DEFINITIONS

Definitions were taken from the following sources:

Code of Federal Regulations (CFR) Title 36, *Parks, Forests, and Public Property,* Chapter II, Forest Service, Department of Agriculture; Part 219, Planning, Section A, National Forest System Land and Resource Management Planning; Section 219.3, Definitions and Terminology, Revised July 1, 1998. (Referred to as 36 CFR 219.3)

Interdisciplinary Team on the George Washington & Jefferson National Forests. (Referred to as Forest IDT)

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Agricultural Handbook Number 701–*Landscape Aesthetics: A Handbook for Scenery Management*.

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FSH 2409.13, *Timber Resource Planning Handbook*, WO Amendment 2409.13-92-1, Effective 8/3/92, 05 - Definitions. (Referred to as FSH 2409.13-05)

FSH 2409.15, *Timber Sale Administration Handbook*, Amendment No. 2409.15-96-2, Effective Sept. 19, 1996, 05 - Definitions. (Referred to as FSH 2409.15-05)

FSH 2409.17, *Silvicultural Practices Handbook*, 1/85 WO, Chapter 9 - Timber Stocking Guides and Growth Predictions, 9.05 - Definitions. (Referred to as FSH 2409.17-9.05)

FSH 2609.13, *Wildlife and Fisheries Program Management Handbook*, WO Amendment 2609.13-92-1, Effective 8/3/92, Chapter 70 - Analysis of Economic Efficiency of Wildlife and Fisheries Projects, 70.5 - Definitions. (Referred to as FSH 2609.70.5)

FSH 2709.12, *Road Rights-of-Way Grants Handbook*, 9/85 WO, Zero Code, 05 - Definitions. (Referred to as FSH 2709.12-05)

Forest Service Manual (FSM) 1900 - Planning, Amendment No. 1900-91-3, Effective March 15, 1991, 1905 - Definitions. (FSM 1905)

FSM 2163, *Hazardous Waste Management*, Chapter 2163.05, Definitions. (Referred to as FSM 2163)

FSM 2200, *Range Management*, WO Amendment 2200-91-1 Effective 3/1/91, Chapter 2230, Grazing and Livestock Use Permit System, 2230.5 - Definitions. (Referred to as FSM 2230)

FSM 2300, *Recreation, Wilderness, and Related Resource Management*, Amendment No. 2300-91-3 Effective March 12, 1991. Chapter 2355, Off-Road Vehicle Use Management, Executive Order 116-44, as amended by Executive Order 11989, Use of Off-Road Vehicles on the Public Lands 37 FR 2877 (Feb. 9, 1972), 42 FR 26959 (May 25, 1977). (Referred to as FSM 2355)

FSM 2300, *Recreation, Wilderness, and Related Resource Management*, WO AFSM 2300 - Recreation, Wilderness, and Related Resource Management, WO Amendment 2300-90-1, Effective 6/1/90, Chapter 2310 - Planning and Data Management - 2312 - Recreation Information Management (RIM). (Referred to as (FSM 2312)

FSM 2400, *Timber Management*, WO Amendment 2400-96-6 Effective 9/24/96. Chapter 2435 - Salvage Sales. 2435.05, Definitions. (FSM 2435)

FSM 2500, *Watershed and Air Management*, Amendment No. 2500-94-4, Effective Dec. 20, 1994. Chapter 2520, Watershed Protection and Management. 2521 - Watershed Condition Assessment. 2521.05 - Definitions. (Referred to as FSM 2521)

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FSM 2500, *Watershed and Air Management*, Amendment No. 2500-94-4, Effective Dec. 20, 1994. Chapter 2520, Watershed Protection and Management. FSM 2526 - Riparian Area Management. 2526.05 - Definitions. (Referred to as FSM 2526)

FSM 2600, *Wildlife, Fish, and Sensitive Plant Habitat Management*, Amendment No. 2600-91-8 Effective Oct. 22, 1991, Chapter 2605, Definitions. (Referred to as FSM 2605)

FSM 2600, *Wildlife, Fish, and Sensitive Plant Habitat Management*, WO Amendment 2600-95-7, Effective 6/23/95, Chapter 2670, Threatened, Endangered, and Sensitive Plants and Animals, 2670.5 - Definitions. (Referred to as FSM 2670)

A User's Guide to Forest Information Retrieval (FIR), Southeastern Forest Experiment Station, Forest Inventory and Analysis Unit, Asheville, NC, 1988. (Referred to as FIR)

Interim Resource Inventory Glossary, File 1900, Washington, DC, 96 p., June 14, 1989. (Referred to IRIG)

DEFINITIONS

A

abiotic: Not related to, or caused by, living organisms. For example, the climate is an abiotic component of ecosystems.

accessibility: The relative ease or difficulty of getting from or to someplace, especially the ability of a site, facility or opportunity to be used 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.

acid deposition: Rain, snow, or particulate matter containing high concentrations of acid anions (e.g. nitrate and sulfate), usually produced by atmospheric transformation of the byproducts of fossil fuel combustion. Precipitation with a pH lower than 5.0 is generally considered to be acidic.

acid neutralizing capacity: The total capacity of a water sample to neutralize acids, as determined by titration with a strong acid. Acid neutralizing capacity includes alkalinity (e. g. carbonate) plus base cations.

acidification: To convert into an acid or become acid.

acre-foot: A measurement of water volume, equal to the amount of water that would cover an area of 1 acre to a depth of 1 foot (specifically 43,560 cubic feet or 325,851 gallons).

activity: A measure, course of action, or treatment that is undertaken to directly or indirectly produce, enhance, or maintain forest and rangeland outputs or achieve administrative or environmental quality objectives.

adaptive management: A dynamic approach to forest management in which the effects of treatments and decisions are continually monitored and used, along with research results, to modify management on a continuing basis to ensure objectives are being met.

administrative unit: All the National Forest System lands where one forest supervisor has responsibility. The basic geographic management area within a Forest Service Region, station, or area.

advance regeneration (reproduction): Seedlings or saplings that develop, or are present, in the understory.

aerial logging: A yarding system employing aerial means, (e.g., helicopters, balloons), to lift logs.

age class distribution: An age-class is a distinct aggregation of trees originating from a single natural event or regeneration activity, or a grouping of trees, e.g., a 10-year age class, as used in inventory or management. An age-class distribution is the location and/ or proportionate representation of different age classes in a forest.

DEFINITIONS:

AGRICULTURAL LAND

ALLOWABLE SALE QUANTITY

agricultural land: Areas used primarily for production of food and/or fiber (excludes wood fiber). Examples include cropland, pasture, orchards, vineyards, nurseries, confined feeding areas, farmsteads, and ranch headquarters.

air pollution: Any substance or energy form (heat, light, noise, etc.) that alters the state of the air from what would naturally occur.

air quality class: Three broad classifications used to prevent significant deterioration of air quality for all areas of the country.

Class I: All areas where essentially any degradation of air quality would be considered significant deterioration.

Class II: All areas where moderate degradation over baseline concentrations are allowed.

Class III: All others.

air quality (PSD) class: Three broad classifications established by the Clean Air Act to help prevent significant deterioration of air quality for all areas of the country that are known (or assumed) to be attaining NAAQS.

Class I: Select wilderness areas and national parks where identified air quality related values might become (or currently are) adversely affected by even a small increment of additional air pollution. To date, there are 156 such areas, nation-wide.

Class II: Areas the states may designate to receive such additional amount of air pollution (even up to 30 times the Class I area increment) that air quality may deteriorate from baseline to (but not below) NAAQS. To date, there are no such areas, nation-wide.

Class III: All other areas, by default, where a moderate level of additional air pollution is deemed acceptable. The bulk of the U.S.

air quality related values: Terminology used in the PSD portion of the Clean Air Act describing values associated with certain resources that may become impaired by air pollution. Typically, these include aquatic habitats, terrestrial habitats and visibility. Visibility refers to the ability of an air mass to convey the landscape image.

all aged stand: See uneven-aged.

allocated fund: Funds transferred from one agency or bureau to another for carrying out the purpose of the parent appropriation and agency.

allocation: The assignment of management prescriptions or combination of management practices to a particular land area to achieve the goals and objectives of the alternative.

allopatric: Condition where one species lives in a section of stream without other closely related species. The species have disjunct distributions. Opposite of sympatric.

allotment management plan: The basic land unit used to facilitate management of the range resource on National Forest System and associated lands administered by the Forest Service.

allowable sale quantity (ASQ): The quantity of timber that may be sold from the area of suitable land covered by the Forest Plan for a time period specified by the Forest Plan. This quantity is usually expressed on an annual basis as the “average annual allowable sale quantity. ” (36 CFR 219.3, 1982).

all-terrain vehicle (ATV): Any motorized, off-highway vehicle 50 inches or less in width, having a dry weight of 600 pounds or less that travels straddled by the operator.

alternative: In forest 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.

amenity values: Features or qualities which are pleasurable or aesthetic, as contrasted with the utilitarian features of a plan, project, location, or resource.

analysis area: A collection of lands, not necessary contiguous, sufficiently similar in character, that they may be treated as if they were identical.

analysis area identifier: A resource characteristic used to stratify the land into capability areas and analysis areas.

Analysis of the Management Situation (AMS): A determination of the ability of the planning area to supply goods and services in response to society's demand. The Forest Plan includes a summary of the AMS. Information from it is contained throughout the EIS/ Plan.

animal unit month: The quantity of forage required by one mature cow and her calf (or the equivalent, in sheep or horses), for one month; 682 pounds of air-dry forage.

annual forest program: The summary or aggregation of all projects that make up an integrated (multifunctional) course of action for a given level of funding of a forest planning area that is consistent with the Forest Plan.

annual work planning process: Preparation of technical plans that serve to implement land and resource management, and program decisions contained in the integrated land, resource plans, and budget allocations.

appropriated fund: Funds available for obligation or outlay by Congress to a given agency.

appropriate management response: The response to a wildland fire based on an evaluation of risks to firefighter and public safety. Evaluation includes the consideration of: circumstances under which the fire occurs, including weather and fuel conditions; natural and cultural resource management objectives; protection priorities; and values to be protected. The evaluation must also include an analysis of the context of the specific fire within the overall logic, geographic area, or national wildland fire situation.

aquatic ecosystem: Components that include: the stream channel, lake and estuary beds, water, biotic community, and associated habitat features. Also included are streams and lakes with intermittently, semipermanently, and seasonally flooded channels or streambeds. In the absence of flowing water, intermittent streams may have pools or surface water.

aquatic habitat types: The classification of instream habitat based on location within channel, patterns of water flow, and nature of flow controlling structures. Habitat is classified into a number of types according to location within the channel, patterns of water flow, and nature of flow controlling structure. Riffles are divided into three habitat types: low gradient riffles, rapids, and cascades. Pools are divided into seven types: secondary channel pools, backward pools, trench pools, plunge pools, lateral scour pools, dammed pools, and beaver ponds. Glides, the third habitat type, are intermediate in many characteristics between riffles and pools. It is recognized that as aquatic habitat types occur in

DEFINITIONS

ARTERIAL ROADS

BIOLOGICAL EVALUATION

various parts of the country, additional habitat types may have to be described. If necessary, the regional fishery biologist will describe and define the additional habitat types.

arterial roads: Roads that provide service to large land areas and usually connect with public highways or other forest arterial roads to form an integrated network of primary travel routes. The location and standard are often determined by a demand for maximum mobility and travel efficiency rather than specific resource management service. They are usually developed and operated for long-term land and resource management purposes and constant service. These roads generally serve areas more than 40,000 acres.

authorized use: Specific activity or occupancy, including a ski area, historical marker, or oil and gas lease, for which a special authorization is issued.

B

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 then 1 inch above soil level. Trees: the cross-section area of a tree stem in square feet commonly measured at breast height (4.5' above ground) and inclusive of bark, usually computed by using diameter at breast height (DBH), or tallied through the use of basal area factor angle gauge.

basal spray: The application of a pesticide, usually a herbicide for controlling brush or weed trees, directed at the base of the stem.

base sale schedule: A timber sale schedule formulated on the basis that the quantity of timber planned for sale and harvest for any future decade is equal to, or greater than, the planned sale and harvest for the preceding decade. The planned sale and harvest for any decade must not be greater than the long-term sustained yield capacity. (36 CFR 219.3, 1982 rule)

best management practice (BMP): A practice, or a combination of practices determined to be the most effective and practical means of preventing or reducing the amount of pollution generated by non-point sources to a level compatible with water quality goals.

biodiversity: The variety of life in an area, including the variety of gene pools, species, plant and animal communities, ecosystems, and the processes through which individual organisms interact with one another, and their environments.

biological assessment (BA): A “biological evaluation” conducted for major federal construction 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 a federally listed species.

biological control: The use of natural means, or agents, to control unwanted pests. Examples include introduced or naturally occurring insects, bacteria, or fungi that act as predators, parasites, or disease agents of pests. Biological controls can sometimes be alternatives to mechanical or chemical means.

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 endangered, threatened, or sensitive species.

biological growth potential: The average net growth attainable on a fully-stocked natural forest land.

biological oxygen demand: Dissolved oxygen required by organisms for the aerobic biochemical decomposition of organic matter present in water.

biotic: Refers to live components of an ecosystem. For example, green plants and soil microorganisms are biotic components of ecosystems.

board foot: A unit of timber measurement equaling the amount of wood contained in an unfinished board 1 inch thick, 12 inches long, and 12 inches wide. Commonly, 1,000 board feet is written as 1 MBF, and 1,000,000 board feet is written as 1MMBF. The conversion factor used in the preparation of this document is 5.5 board feet = 1 cubic foot.

browse: Young twigs, leaves and tender shoots of plants, shrubs or trees that animals eat.

C

cable logging: A term for any system involving transport of logs along, or by means of steel cables with the load being lifted partly or wholly off the ground.

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.

capability: The potential of a land area to produce resources, supply goods and services, and allow resource uses under an assumed set of management practices and a given level of management intensity. Note: capability depends upon the current condition and site conditions including climate, slope, land form, soil and geology, and the application of management practices and protection from fire, insects, and disease.

carrying capacity: The number of organisms of a given species and quality that can survive in, without causing deterioration of, a given ecosystem through the least favorable environmental conditions that occur within a stated interval of time.

channelled ephemeral streams: Ephemeral streams that have a defined channel of flow where surface water converges with enough energy to remove soil, organic matter, and leaf litter. Ones that exhibit an ordinary high watermark and show signs of annual scour or sediment transport are considered navigable waters of the United States (USACE, Part 330: Nationwide Permit program, 2000).

chemical control: The use of pesticides to control pests or undesirable species. Contrast with biological control and mechanical control.

chemical site preparation: The killing or retardation of competing vegetation to prepare an area for reforestation, using herbicide.

class I areas: See air quality class.

cleaning: A release treatment made in an age class, not past the sapling stage, in order to free the favored trees from less desirable individuals of the same age class which can overtop them.

DEFINITIONS

CLEARCUTTING

CONCENTRATED USE

clearcutting: The harvesting in one cut of all trees on an area for the purpose of creating a new, even-aged stand. The area harvested may be a patch, stand, or strip large enough to be mapped or recorded as a separate age class in planning for sustained yield under area regulation. A method of regenerating an even-aged stand. Regeneration is from natural seeding, direct seeding, planted seedlings, and/or advance reproduction. Harvesting may be done in groups or patches (group or patch clearcutting), or in strips (strip clearcutting). In the clearcutting system, the management unit or stand in which regeneration, growth, and yield are regulated consists of the individual clearcut stand.

clearcutting with reserves: A two-aged regeneration method in which varying numbers of reserve trees are not harvested to attain goals other than regeneration.

climax: The culminating stage in plant succession for a given environment with the vegetation having reached a highly stable condition.

coarse woody debris: See large woody debris.

co-dominant trees: Trees or shrubs with crowns receiving full light from above, but comparatively little from the sides. Crowns usually form the general level of the canopy.

cold water fishery: Aquatic habitats that predominately support fish species that have temperature tolerances up to about 70^{O}F, and exhibit their greatest reproductive success at temperatures below 65^{O}F (18.3^{O}C).

collector road: Roads that serve smaller land areas and are usually connected to a forest arterial or public highway. They collect traffic from forest local roads or terminal facilities. The location and standard are influenced by long-term multi-resource service needs, and travel efficiency. Forest collector roads may be operated for constant or intermittent service, depending on land-use and resource management objectives for the area served by the facility. These roads generally have two or more local roads feeding into them and generally serve an area exceeding 10,000 acres.

commercial forest land: Forest land that can produce crops of industrial wood, and has not been withdrawn by Congress, the Secretary of Agriculture, or the Chief of the Forest Service. Existing technology and knowledge must be available to ensure timber production without irreversible damage to soils productivity, or watershed conditions. Adequate restocking can be attained within five years after final harvesting.

commercial thinning: Any type of thinning producing merchantable material at least equal to the value of the direct cost of harvesting.

commercial tree species: (1) Tree species suitable for industrial wood produces. (2) Conifer and hardwood species used to calculate the commercial forest land allowable sale quality.

commodity outputs: A resource output with commercial value. All resource products that are articles of commerce.

compartment: A portion of a forest under one ownership, usually contiguous and composed of a variety of forest stand types, defined for purposes of locational reference.

composition (stand): The proportion of each tree species in a stand expressed as a percentage of the total number, basal area, or volume of all tree species in the stand.

concentrated use area (CUA): An undeveloped site or area located within a general forest area, generally not in the Infrastructure system, but receiving investments of management time and/or dollars because recreation use leaves evident impacts such as litter, vandalism or soil compaction. Any amenities in a CUA are placed and managed for resource protection rather than user convenience.

concern level: A particular degree or measure of viewer interest in the scenic qualities of the landscape as viewed from travelways and use areas, rated level 1 (highest concern) to 3 (lowest concern).

concession: The granting of an operation and maintenance of a recreation facility to a private business through a special use authorization.

constraint: A restriction or limit that must be met.

Continuous Inventory of Stand Condition (CISC): A system that continuously reflects an up-to-date description of timber stands. It tells what and when actions are planned for stands and gives some information about actions that have taken place. It is also the name of the data base management computer system used for the storage and retrieval of data.

controlled surface use stipulation: Use and occupancy is allowed for fluid mineral development (unless restricted by another stipulation), but the identified resource values require special operational constraints that may modify the lease rights.

conventional logging: A term used to identify methods commonly used in an area to move logs from stump to mill.

conversion (forest management): A change from one forest type to another in a stand on land that has the capability of both forest types.

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.

coppice with reserve: A two-aged regeneration method in which reserve trees are retained to goals other than regeneration. This method normally creates a two-aged stand.

cord: A unit of gross volume measurement for stacked, round wood based on external dimensions, generally implies a stack of 4 x 4 feet vertical cross section and 8 feet long. Contains 128 stacked cubic feet.

corridor: A linear strip of land identified for the present or future location of transportation or utility rights-of-way within its boundaries. It can also be identified for wildlife habitat connecting, or protecting forest resources.

Council on Environmental Quality: An advisory council to the president established by the National Environmental Policy Act of 1969. It reviews federal programs for their effect on the environment, conducts environmental studies, and advises the president on environmental matters.

cove: The head of a small valley or drainage, typically in a moist shaded and protected site.

creel survey: A survey of anglers.

critical habitat: Habitat, determined by the Secretary of Interior, essential to the conservation of the endangered or threatened species.

DEFINITIONS

CROWN CLASS

DENDROPYRO-CHRONOLOGY

crown class: A class of tree based on crown position relative to the crowns of adjacent trees.

dominant: Trees with crowns extending above the general level of the main canopy of even-aged groups of trees. They receive full light from above, and partly from the sides.

co-dominant: Trees with crowns forming the general level of the main canopy in even-aged groups of trees. They receive full light from above, and comparatively little from the sides.

intermediate: Trees with crowns extending into the lower portion of the main canopy of even-aged groups of trees, but shorter in height than the co-dominants. They receive little direct light from above, and none from the sides.

overtopped (suppressed): Trees of varying levels of vigor that have their crowns completely covered by the crowns of one or more neighboring trees.

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: Age at which average rate of annual tree growth stops increasing and begins to decline. Mean annual increment is expressed in cubic feet measure and is based on expected growth, according to the management intensities and utilization standards assumed in accordance with 36 CFR 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: Physical remains of districts, sites, structures, buildings, networks or objects that were used by humans. They may be historic, prehistoric, archaeological, architectural or spiritual in nature. Cultural resources are non-renewable.

cunit: Equivalent to 100 cubic feet of solid wood. Commonly, 100 cubic feet is expressed as 1 CCF.

cutting cycle: The planned interval between partial harvest in a stand being managed with an uneven-aged regeneration method.

D

daylighting: The practices of cutting back edges of roads or trails by removing shrub and tree growth.

decision criteria: Rules or standards used to evaluate and rank alternatives.

decommission: To stabilize or restore a road to a more natural state without any further maintenance. The entrance is obscured and the wheel tracks or pathway is no longer continuous and suitable for travel. The travel way has been removed from the transportation system. The road prism is not necessarily returned back to its original contours.

demand: The amount of an output that users are willing to take at specified price, time period and condition of sale.

demand species: Animal species commonly associated with recreation (e.g. hunting, fishing, viewing).

dendropyrochronology: The science that uses tree rings to date and study past and present changes in wildfires.

den trees: Trees having rainproof, weather: tight cavities used by wildlife.

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 appears when goals have been achieved.

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, and biological opportunities and constraints.

developed recreation: Recreation use or opportunities occurring at developed sites.

developed recreation site: Relatively small, distinctly defined area where facilities are provided for concentrated public use. Examples include campgrounds, picnic areas, and swimming areas.

development level: An indication of site modification based on classes in the Recreation Opportunity Spectrum. Development Level 1 equates to Primitive, with minimum site modification; 2 equates to Semi-Primitive Motorized/Non-motorized, with little site modification; 3 equates to Roaded, with moderate modification; 4 equates to Rural, with heavy site construction; and 5 relates to Urban, with a high degree of site modification. See Facilities level, below, and FSM 2330.3, Exhibit 1.

diameter at breast height (d.b.h.): A tree's diameter measured at about 4.5 feet (1.37m) above the forest floor on the uphill side of the tree. For the purposes of determining breast height, the forest floor includes the duff layer that may be present, but does not include unincorporated woody debris that may rise above the ground line.

diameter class: Any of the intervals into which a range of diameters of tree stems may be divided for classification and use, (e.g., 10-inch class includes diameters from 9.5 inches to 10.49 inches.

dispersed recreation: Recreation opportunities or use occurring in the general forest area. Does not take place in developed sites. Examples are trail use, rock climbing, boating, hunting and fishing.

disturbance (ecology): Any relative discrete event in time that disrupts the ecosystem, community, or population structure and changes resources, substrate availability, or the physical environment.

disturbance-recovery regime: A natural pattern of periodic disturbance followed by a period of recovery. Examples include fire or flooding.

diversity: The distribution and abundance of different plant and animal communities and species within the area covered by a land and resource management plan.

drainage area/basin: The total area above a given point on a stream that contributes to the flow at that point. Term is often used interchangeably with watershed.

drumming log: Drumming logs are large, decaying logs generally used by male ruffed grouse for display purposes. They usually have large overhanging shrub cover. Many of

EARLY SUCCESSIONAL FOREST

ENVIRONMENT

the same drumming locations are used year after year, often by the same male. Drumming centers have a zone of influence of about 20 acres that are usually defended.

E

early successional forest: The biotic community that develops immediately following the removal or mortality of most or all of the forest canopy. As used in the EIS and RLRMP, a stand age of 0 to 10 years.

early successional habitat: Vegetative condition typically characterized by low density to no canopy cover and an abundance of herbaceous ground cover. May include forest 0 to 10 years of age, maintained openings, pastures, balds, or open woodlands.

ecological classification system: A hierarchical system used to help organize and coordinate the classification of ecological types, units, and to make comparisons. Classification is ecologically based and integrates existing resource data including climate, topography, geology, soil, hydrology, and vegetation. The system includes many levels (from the top-down approach): domain, division, province, section, subsection, land type, land type association, land type phase, and site.

ecological management unit: A grouping of one or more soil series that have similar characteristics including texture, structure, or water retention capacity. EMUs are used in soil mapping.

ecosystem: A complete interacting system of organisms and their environment.

ecosystem/cover type: The native vegetation ecological community considered together with non-living factors of the environment as a unit. The general cover type occupying the greatest percent of the stand location. Based on tree or plant species forming a plurality of the stocking within the stand. May be observed in the field, or computed from plot measurements.

ecosystem management: An ecological approach to natural resource management to assure productive, healthy ecosystem by blending social, economic, physical and biological needs and values.

edge effects: Ecological characteristics associated with the junction between two dissimilar habitat types or successional stages that positively or negatively affect species living there.

endangered species: Any species that is in danger of extinction throughout all or a significant portion of its range, other than members of the class Insecta that have been determined by the Department of Interior to constitute a pest whose protection under the provisions of this (Endangered Species Act of 1973) act would present an overwhelming and overriding risk to humans. It must be designated in the *Federal Register* by the appropriate secretary.

endemic: Species restricted to a particular geographic area. Usually limited to one or a few small streams or a single drainage.

ending inventory: The standing volume at the end of the planning horizon. It must be adequate for the maintenance of long-term sustained yield.

environment: All the conditions, circumstances, and influences surrounding and affecting the development of an organism, or group of organisms.

environmental consequence: The result or effect of an action upon the environment.

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. 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.

environmental impact: Used interchangeably with environmental consequence or effect.

ephemeral streams: Streams having flows that occur for short periods of time in direct response to storm precipitation or snowmelt runoff. Their 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 have a defined channel, but may be manifested as a natural swale or depression with vegetation and organic material covering the bottom. They also may serve as a conduit for much of the sediment that enters the stream system. Large woody debris associated with ephemeral streams may also contribute significantly to the stability of a stream system. Ephemeral streams that exhibit an ordinary high watermark, show signs of annual scour or sediment transport, are considered navigable waters of the United States.

erosion: The wearing away of the land surface by the action of wind, water, or gravity.

essential habitat: Habitat in which threatened and endangered species occur, but which has not been declared as critical habitat. Occupied habitat or suitable unoccupied habitat necessary for the protection and recovery of a federally designated threatened or endangered species.

eutrophication: Condition of a lake where deleterious effects are caused by increased nutrients (nitrogen and phosphorous), and a decrease in oxygen.

evapotranspiration: The transfer of water vapor to the atmosphere from soil and water surfaces (evaporation), and from living plant cells (transpiration).

even-aged silvicultural system: A planned sequence of treatments designed to maintain and regenerate a stand with one 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.

existing wilderness: Those areas already designated as wilderness by Congress.

extirpation: Extinction of a species from a part of its range.

F

facilities level: A term that refers to campgrounds, expressed as Development Level 1-5. Customers in levels 1 and 2 campgrounds generally seek a relatively primitive experience with a minimum of facilities for comfort or convenience. Tent camping dominates and spurs are too short to accommodate most RVs. Utilities are not provided and access is difficult. Level 3 developments focus on tent campers and small RVs. Low amperage electrical service may be provided. Water hydrants and flush toilets are typically provided. A moderate degree of accessibility is provided. Level 4 and 5 developments serve users

DEFINITIONS

FACILITY

FIRE USE

with RVs of all types. Showers, flush toilets and other amenities are available; individual water, sewer and electrical hookups are commonly provided.

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 ranger station compound, lookout tower, leased office, work center, separate housing area, visitor center, research laboratory, recreation complex, utility system, or telecommunications site".

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.

Federal Register*:* The designated document that notifies the public of federal actions and includes Notice of Intent, calls for public involvement, etc. It also publishes the regulations needed to implement those federal actions.

federally listed: Any plant or animal species listed as threatened or endangered under the Endangered Species Act.

felling: The cutting down of trees.

final crop: That portion of the growing stock (to be) kept until final commercial harvest, (i. e., final product objective).

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.

fire management effectiveness index: A measure of the effectiveness of annual fire management operational programs. Measured in dollars per thousand acres protected, the objective is to minimize the index value.

fire management plan: Strategic plans that define a program to manage wildland fires based on an area's approved land management plan. They must address a full range of fire management activities that support ecosystem sustainability, values to be protected, protection of firefighter and public safety, public health and environmental issues, and must be consistent with resource management objectives and activities of the area.

fire regime: A generalized description of the role a fire plays in the ecosystem. It is characterized by fire frequency, predictability, seasonality, intensity, duration, scale (patch size), and regularity or variability. Five combinations of fire frequency exist.

fire use: The combination of wildland fire use and prescribed fire application to meet resource objectives.

fisheries classification: Water bodies and streams classed as having a cold: or warm-water fishery. This designation is dependent upon the dominant species of fish occupying the water.

fisheries habitat: Streams, lakes, and reservoirs that support fish.

floodplains: Lowland or relatively flat areas joining inland and coastal water including, at a minimum, that area subject to a 1-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.

forage: All browse and non-woody plants that are available to livestock or game animals used for grazing or harvested for feeding.

forage production: The weight of forage that is produced within a designated period of time on a given area. The weight may be expressed as green, air dry, or oven dry. The term may also be modified as to time of production including annual, current years, or seasonal forage production.

foreground: The area between the viewer and the middle ground in a landscape; generally from 0 to 1/2 mile distance.

forest development road: A road wholly or partly within, or adjacent to, and serving a part of the National Forest System. It also has been included in the Forest Development Road System Plan.

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 at least 10 percent occupied by forest trees of any size, or formerly having had such tree cover, and not currently developed for non-forest use. Lands developed for non-forest use including areas for crops, improved pasture, residential, or administrative areas, improved roads of any width, adjoining road clearing, and power line clearing of any width.

Forest and Rangeland Renewable Resources Planning Act of 1974: An act of Congress requiring the preparation of a program for the management of the national forests' renewable resources, and of land and resource management plans for units of the National Forest System. It also requires a continuing inventory of all National Forest System lands and renewable resources.

Forest Service Handbook (FSH): A handbook that provides detailed instructions for proceeding with specialized phases of programs or activities for Forest Service use.

Forest Service Manual (FSM): Agency manuals that provide direction for Forest Service activities.

forest trail system: Trails that are part of the forest transportation system. A designated path commonly used and maintained for hikers, horse riders, bicycles, or two-wheeled motorized vehicles.

forest type: A descriptive term used to group stands of similar composition and development because of given ecological factors, by which they may be differentiated from other groups of stands.

DEFINITIONS

FOREST SUPERVISOR

GRASSLAND

forest supervisor: The official responsible for administering the National Forest System lands in a Forest Service administrative unit. It may consist of two or more national forests or all the forests within a state. The supervisor reports to the regional forester.

forestwide standard: A performance criterion indicating acceptable norms, specification, or quality that actions must meet to maintain the minimum considerations for a particular resource. This type of standard applies to all areas of the forest regardless of the other management prescriptions applied.

free-to-grow: A seedling or small tree free from direct competition from other trees, shrubs, grasses, or herbaceous plants.

fuel break: Any natural or constructed barrier used to segregate, stop, and control the spread of fire, or to provide a control line from which to work.

fuel loading: The amount of fuel (flammable natural materials) expressed quantitatively in terms of weight of fuel per unit area.

fuel treatment: The rearrangement or disposal of fuels to reduce fire hazard. Fuels are defined as living and dead vegetative materials consumable by fire.

fuels management: The planned treatment of fuels to achieve or maintain desired fuels conditions.

fuelwood: Wood used for conversion to some form of energy.

G

game species: Any species of wildlife or fish for which seasons and bag limits have been prescribed, and which are normally harvested by hunters, trappers, and fishermen under state or federal laws, codes, and regulations.

geologic features: Landforms or other features of significant geologic interest that may require special management to protect the special qualities, or provide interpretation to the public.

geologic formation: A mappable body of rock identified by distinctive characteristics, some degree of internal homogeneity, and stratigraphic position. The name normally consists of two parts. The first is the name of the geographic locality where the formation was first identified and described. This is followed by a descriptive geologic term, usually the dominant rock type.

Geographic Information System (GIS): 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.

goal: In planning, a concise statement that describes a desired future condition to be achieved with no specific date by which it is to be attained. It is normally expressed in broad, general terms. Goal statements form the principal basis from which objectives are derived.

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. Examples include tall grass and short grass prairies, meadows, cordgrass marshes, sphagnum moss areas, pasturelands, and areas cut for hay.

grazing: Consumption of range or pasture forage by animals.

grazing capacity: The maximum stocking rate possible without inducing damage to vegetation or related resources.

grazing permit: Official, written permission to graze a specified number, kind, and class of livestock for a specific period on a defined range allotment.

gross receipts: A total of all funds received by the U.S. Treasury as a result of Forest Service activities.

groundwater: Water in a saturated zone in a geologic stratum. Water stored below the water table where the soil (or other geologic material) is saturated.

group selection: An uneven-aged regeneration method in which trees are removed periodically in small groups. Uneven age classes for trees are established in small groups. The width of groups is about twice the height of the mature trees, with small opening providing microenvironments suitable for tolerant regeneration, and the larger openings providing conditions suitable for more intolerant regeneration.

growing stock trees: Live trees, meeting specified standards of quality or vigor, included in growth and yield projections to arrive at the allowable sale quantity.

growing stock volume: Volume (cubic feet) of solid wood in growing stock trees 5 inches DBH and larger, from a 1-foot stump to a minimum 4-inch top diameter, outside bark, on the central stem. Volume of solid wood in primary forks from the point of occurrence to a minimum 4-inch top diameter outside bark is included.

H

habitat: The native environment of an animal or plant in which all the essentials for its development, existence, and reproduction are present.

harvest cutting: An intermediate or final cutting that extracts salable trees.

harvesting method: A procedure by which a stand is logged. Emphasis is on meeting logging requirements rather than silvicultural objectives.

herbicide: A pesticide used for killing or controlling the growth of undesirable plants.

heritage sites and 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.

hibernaculum (plural is hibernacula): A wintering area (usually underground) for bats (caves, rockshelters, mines). Typically, hibernacula provide a cold but not freezing temperature and relative high humidity. Different bat species have different environment requirements for their hibernacula.

DEFINITIONS

HISTORIC LANDSCAPE

INSTREAM FLOW

historic landscapes: Industrial, agricultural, pastoral or domestic landscapes that have evolved over many years from human alteration. Commonly functional and often vernacular, the landscapes 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.

hydric soils: Soils developed in conditions where soil oxygen is limited by the presence of saturated soil for long periods during the growing season.

Hydrologic Unit Code (HUC): A cataloging system developed by the US Geological Survey and the Natural Resource Conservation Service to identify watersheds, and to standardize hydrological unit delineations for geographic description and data storage purposes.

I

immediate foreground: The area in the landscape from the viewer out to 300 feet distance.

impaired stream: Waters are defined as impaired when they do not support, or only partially support, one or more of five designated uses, (i.e. aquatic life, fish consumption, shellfish consumption, swimming, and drinking water). Support of the designated uses is based on compliance with Virginia's Water Quality Standards which include numeric and narrative criteria. Compliance is determined by the assessment of all available monitoring data and water quality information.

improved pasture: Fenced, fertilized pastures intensively managed for livestock grazing.

improvement cutting: The removal of less desirable trees in a stand of poles or larger trees, primarily to improve composition and quality.

industrial wood: All commercial round wood products, except fuelwood.

infestation: The attack by macroscopic organisms in considerable concentration. Examples are infestations of tree crowns by gypsy moth, 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 O&M costs, recreation funding shortfalls, recreation use data, information on accessibility, and inventories of facilities. INFRA brings together Oracle, Arc Info and Arc View GIS technology, and supplements recreation management systems including SMS, ROS and Benefits Based Management.

initial attack: The aggressive response to a wildland fire based on values to be protected, benefits of response, and reasonable cost of response.

instream flow: The presence of adequate stream flow in channels necessary to maintain the integrity of the stream channel, and protection of downstream beneficial uses including fish and wildlife needs, outdoor recreation uses of water, and livestock watering needs.

integrated pest management (IPM): The maintenance of destructive agents, including insects at tolerable levels, by the planned use of a variety of preventive, suppressive, or regulatory tactics and strategies that are ecologically and economically efficient and socially acceptable.

interdisciplinary team: A group of individuals with skills for management of different resources (e.g.: wildlife biologist, hydrologist, forester, etc.). An interdisciplinary team is assembled because no single scientific discipline is sufficient to adequately identify and resolve issues and problems. Team members ensure integrated use of natural and social sciences as required by the NEPA and NFMA.

interior forest habitat: High canopy forest conditions suitable to meet the requirements of area-sensitive species that are adversely impacted by forest edge, including microclimate change (warmer, windier), increased predation, increased brood parasitism, and increased competition.

intermediate treatments: A collective term for any treatment designed to enhance growth, quality, vigor, and composition of the stand after establishment of regeneration and prior to final harvest. Types include thinning, release and improvement cuttings.

intermittent streams: Streams that 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 channel 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.

interpretive association: A nonprofit, tax-exempt corporation or organization whose purpose is extending and enhancing the ability of the Forest Service to provide customer service to National Forest visitors. They work cooperatively with the Forest Service in educating the public about natural and cultural issues on public lands.

interpretive services: Visitor information services designed to present inspirational, educational, and recreational values to forest visitors in an effort to promote understanding, appreciation, and enjoyment of their forest experience.

intolerant: A plant requiring sunlight and exposure for establishment and growth.

invasive species: A species that can move into an area and become dominant either numerically or in terms of cover, resource use, or other ecological impacts. An invasive species may be native or non-native.

inventoried roadless area: Areas identified in a set of inventoried roadless area maps, contained in Forest Service Roadless Area Conservation, Final Environmental Impact Statement, Volume 2, dated November 2000, or any subsequent update or revision of those maps. (36 CFR 294.11)

irretrievable impact: Refers to commitments that are lost for a period of time. For example, while an area is used as a developed recreation site, some or all of the timber production there is irretrievably lost. If the recreation area closes, timber production could resume. However, the lost of timber production during that time of irretrievability is not irreversible, because it is possible for timber production to resume if the area is no longer used as a recreation site. Contrast with irreversible impact.

irreversible impact: Refers to commitments that cannot be reverse, except perhaps in the extreme long term. For example, once coal has been removed, it will not be replaced within any measurable time period. Contrast with irretrievable impact.

K

karstland: Land underlain by limestone and characterized by sinks, abrupt ridges, irregular rock outcrops, caverns and underground streams.

L

land acquisition: Obtaining full landownership rights by donation, purchase, exchange, or condemnation.

land exchange: The conveyance of non-federal land or interests in the land in exchange for National Forest System land or interests in land.

landing: A cleared area in the forest to which logs are yarded or skidded for loading onto trucks for transport.

landline location: Legal identification and accurate location of national forest property boundaries.

land management planning: A formal process of management planning involving four interactive steps: monitoring, assessment, decision making, and implementations as described in the Federal Code of Regulations.

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 a landscape that give it an image and make it more identifiable or unique. Levels include Natural Evolving, Natural Appearing, Pastoral/Agricultural, Historic, Transitional, Suburban, and Urban.

landtype: An intermediate level in the ecological classification system hierarchy that addresses land areas ranging in size from hundreds of acres up to ten thousands of acres. These units typically have similarities in landform, natural vegetative communities, and soils.

landtype association: A group of landtypes. The landtypes in the association are sufficiently homogeneous to be considered as a whole for modeling the future outputs and effects of planned management activities. Landtype associations may not follow watershed boundaries, and are defined on the basis of general similarities in climate, geology, landform, and vegetation.

landtype phase: The most detailed level in the ecological classification system hierarchy that addresses local geology, soils, streams, and vegetation types. Land areas are generally less than 100 acres in size.

landslide: A general term for a mass movement landform. Types of landslides include creep, rock slides and falls, earthflows, debris flows, and avalanches.

large woody debris (LWD): Any piece(s) of dead woody material, e.g., dead boles, limbs, and large root masses, on the ground in forest stands, or in streams. Sometimes called coarse woody debris (CWD).

late successional (seral) stage: The stage of forest development at which overstory trees have attained most of expected height growth and have reached ecological maturity. As used in the EIS and RLRMP, a stand age greater than 80 years. Old-growth forests occur during the later periods of this stage at ages that vary by forest community type.

leasable minerals: See minerals (leasable).

lease: A contract between the landowner and another granting the latter the right to search for and produce oil, gas, or other mineral substances (as specified in the document) on payment of an agreed rental, bonus, or royalty. This right is subject to the terms, conditions, and limitations specified in the document.

leave tree: A tree (marked to be) left standing for wildlife, seed production, etc, in an area where it might otherwise be felled.

limits of acceptable change (LAC): A system in which the amount of change to be allowed is defined explicitly by means of quantitative standards and the appropriate management actions needed to prevent further change are identified, and procedures for monitoring and evaluating performances are established.

locally rare species: A term used by USDA Forest Service to describe species for which representation on a particular forest is a concern.

logging: The felling, skidding, on-site processing, and loading of trees or logs onto trucks.

long-term sustained-yield capacity: The highest uniform wood yield from lands being managed for timber production that may be sustained under a specified management intensity, consistent with multiple-use objectives. (36 CFR 219.3, 1982 rule)

low PSI skidder: A term used to identify any one of several types of vehicles used to move logs from stump to log loading area. Low PSI (pounds per square inch) identifies those vehicles that, because of design of tracks, wheels, or suspension system, exert much lower pressure on ground surface than other types of ground-based skidding vehicles.

M

management action: A set of management activities applied to a land area to produced a desired output.

management area: A Forest Planning term denoting a contiguous geographic area of land with similar physical, biological, or social factors which influence management decisions. Each management area is allocated to one or more management prescriptions.

Management Attainment Report (MAR): A process used in determining whether work is progressing as planned. It provides the manager with information for measuring progress against objectives, information for measuring self and subordinates’ performance, and an indication of a reporting unit’s performance.

management direction: A statement of multiple-use goals, objectives, and standards for attaining them. Management direction is expressed forestwide, by management prescription, and by management area.

management emphasis: The multiple-use values to be featured or enhanced within a given management prescription or management area.

DEFINITIONS

MANAGEMENT INDICATOR SPECIES

MINERAL MATERIALS

management indicator species (MIS): 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 Forest Plan implementation. They are chosen because their population changes are believed to indicate the effects of management on selected biological components.

management intensity: A management practice or combination of management practices and associated costs designed to obtain different levels of goods and services.

management practice: A specific action, measure, course of action, or treatment undertaken on a forest.

management prescription: A Forest Planning term denoting areas of land with similar desired conditions, objectives, and standards for achieving them. Management practices and intensity are selected and scheduled for implementation to attain multiple-use goals and objectives.

management type: The tree species or species group that should be grown on a specific site, whether or not it presently occupies the site that best suits the particular site soil, aspect, elevation, and moisture provided by the area and the forest plan's objectives.

manual site preparation: The killing or retardation of competing vegetation to prepare for an area for reforestation, using hand or power tools such as chainsaws.

mast tree: Generally hardwood trees of the heavy seeded variety including oaks, hickories, walnut, beech: 25 years and older capable of producing frequent seed crops to feed a variety of wildlife species.

maximum modification: A visual quality objective in which human activities may dominate the characteristic landscape, but should appear as a natural occurrence when viewed as background.

mean annual increment of growth: The total increase in girth, diameter, basal area, height, or volume of individual trees or a stand up to a given age divided by that age.

meaningful measures: A moniker for the Forest Service's National Recreation Business Management System, MM is a six-step management system for professional, accountable and visitor-responsive site and project-level management. Accomplishment is measured by established standards of quality for recreation services; the system determines costs to attain those standards, sets priorities for work to be accomplished and budget allocations, and measures the actual success at attaining these quality standards.

mesic: Sites or habitats characterized by intermediate moisture conditions, i.e., neither decidedly wet or dry.

middle ground: The space between the foreground and the background in a picture or landscape; generally 1/2 mile to 4 miles distance from the viewer.

mid successional (seral) stage: The state of forest development during which distinct overstory, midstory, and understory canopies are developed. Hard mast production is greatest during this stage. As used in the EIS and RLRMP, a stand age of 41 to 80 years.

mineral exploration: The search for valuable minerals on lands open to mineral entry.

mineral materials: Materials such as road aggregate, landscaping rock, rip-rap, and other earthern construction materials. These materials are used to build and maintain trails, roads, and campgrounds; to restore riparian and aquatic habitat; to repair flood damage, etc.

mineral soil: Weathered rock materials without any vegetative cover.

mineral resource: A known or undiscovered concentration of naturally occurring solid, liquid, or gaseous material in or on the earth's crust in such form and amount that economic extraction of a commodity from the concentration is currently or potentially feasible.

minerals (leasable): Coal, oil, gas, phosphate, sodium, potassium, oil shale, sulphur, and geothermal steam. All hard-rock minerals that occur on acquired lands, as opposed to public domain lands, are leasable.

minimum management requirement: Any constraint imposed to comply with 36 CFR 219.27 and other legal restrictions that must be met by benchmark solutions as noted in 36 CFR 219.11(e)(1). These include requirements including conserving soil productivity, maintaining minimum viable populations of wildlife, preserving the habitat of endangered species' habitat, dispersing openings, and limiting cut size. It also includes any other standards and guidelines, including best management practices that serve to define management prescriptions and resource response.

mitigation: Actions to avoid, minimize, reduce, eliminate, or rectify the impact of a management practice.

mixed mesophytic forest: A forest containing tree (mostly hardwood) and plant species, which normally grow in moderately moist soils, typically in coves, or in riparian areas.

modification: A visual quality objective in which human activity may dominate the characteristic landscape but must, at the same time, use naturally established form, line, color, and texture appearing as a natural occurrence when viewed in foreground or middle ground.

monitoring: The periodic evaluation on a sample basis of Forest Plan management practices to determine how fully objectives have been met, how closely management standards have been applied, and what effects those practices had on the land and environment.

montane: Relating to the zone of relatively moist, cool upland slopes characterized by the presence of large evergreen trees as a dominant life form.

mortality: Dead or dying trees resulting from forest fire, insect, diseases, or climatic factors.

motorized equipment: Machines that use a motor, engine, or other non-living power source. This includes, but is not limited to such machines as chain saws, aircraft, snowmobiles, generators, motor boats, and motor vehicles. It does not include small battery or gas powered hand carried devices such as shavers, wristwatches, flashlights, cameras, stoves, or other similar small equipment.

multiple use: The management of all the various renewable surface resources of the National Forest System 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. (36 CFR 219.3, 1982)

N

National Forest Land and Resource Management Plan (Forest Plan): A plan developed to meet the requirements of the Forest and Rangeland Renewable Resources Planning Act of 1974, as amended, that guides all natural resource management activities and establishes management standards and guidelines for the National Forest System lands of a given national forest.

National Forest System (NFS): All national forest lands reserved or withdrawn from public domain of the United States and acquired through purchase, exchange, donation, annuor other means. National Grasslands and land utilization projects administered under Title III of the Bankhead–Jones Farm Tenant Act (50 Stat. 525, 7 U.S.C. 1010–1012), and other lands, waters, or interests that are administered by the Forest Service, or are designated for administration through the Forest Service as a part of the system.

National Forest System Land: Federal land that has been legally designated as national forests or purchase units, and other land under the administration of the Forest Service, including experimental areas and Bankhead-Jones Title III land.

National Historic Landmark: Cultural properties designated by the Secretary of the Interior as being nationally significant. These cultural properties may be buildings, historic districts, structures, sites and objects that possess exceptional value in commemorating or illustrating the history of the United States.

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 archaeological resources. Properties listed in the National Register include districts, sites, buildings, structures, and objects that are significant in American history, architecture, archaeology, 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: A systematic process to estimate al recreation and other uses of National Forest lands through user surveys.

National Wild and Scenic Rivers System: Rivers with scenic, recreational, geologic, fish and wildlife, historic, cultural, or other similar values designated by Congress under the Wild and Scenic Rivers Act of Oct. 2, 1968, for preservation of their free-flowing condition.

National Wilderness Preservation System: All lands covered by the Wilderness Act and subsequent wilderness designations, irrespective of the department or agency having jurisdiction.

National Visitor Use Monitoring (NVUM): A systematic process to estimate annual recreation and other uses of National Forest lands through user surveys.

natural range of variability: In planning, the full range of ecosystem processes and disturbance regimes that occur withing the current climatic period.

net annual growth: The net change in merchantable volume expressed as an annual average between surveys in the absence of cutting (gross growth minus mortality).

net public benefits: 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. Net public benefits are measured by quantitative and qualitative criteria rather than a single measure or index. The maximization of net public benefits to be derived from management of units of the National Forest System is consistent with the principles of multiple use and sustained yield.

no-action alternative: The most likely condition expected to exist in the future if current management direction would continue unchanged.

no surface occupancy (NSO): Use or occupancy of the land surface for fluid mineral exploration or development is prohibited to protect the identified resource values.

non-attainment area: For National Ambient Air Quality Standards (NAAQS), where the pattern of “violations of standard” is sufficient to require remedial action; a boundary is determined around the location of the violations. The area within that boundary is designated to be in non-attainment of the particular NAAQS standard and an enforceable plan is developed to prevent additional violations.

non-chargable volume: All volume not included in the growth and yield projections for the selected management prescriptions used to arrive at the allowable sale quantity.

non-commercial thinning: The thinning of commercial-size trees without a subsequent sale of associated wood products. Also called a pre-commercial thinning.

non-commodity output: A resource output that cannot be bought and sold.

non-declining yield: A level of timber production planned so that the planned sale and harvest for any future decade is equal to, or greater than the planned sale and harvest for the preceding decade.

non-forest land: Land that has never supported forests and lands formerly forested where use for timber utilization is precluded by development for other use. Lands that never have had, or that are incapable of having 10 percent or more of the area occupied by forest trees; or lands previously having such cover and currently developed for non-forest use.

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-point source pollution: A diffuse source of pollution not regulated as a point source. May include atmospheric, deposition, agricultural runoff, and sediment from land-distributing activities.

non-stocked stands: Stands less than 16.7 percent stocked with growing stock trees.

non-timber forest products: All forest products except timber, including resins, oils, leaves, bark, plants other than trees, fungi, and animals or animal products.

O

objective: A concise, time-specific statement of measurable planned results that respond to pre-established goals. It forms the basis for further planning to define the precise steps to be taken and the resources to be used in achieving identified goals.

off-highway vehicle (OHV): Any vehicles capable of being operated off established roads; e.g. motorbikes, four-wheel drives and snowmobiles.

offstream use: Water withdrawn or diverted from a ground or surface-water source for public water supply, industry, irrigation, livestock, thermoelectric power generation, and other uses.

old field: Idle or abandoned farmland or pasture that is reverting to shrubland or forest.

on-site: A term referring to species normally found on a site under natural conditions. The same or contiguous property that may be divided by a public or private right-of-way, provided that the entrance and exit between the properties is at a crossroads intersection, and that access is by crossing, as opposed to going along the right-of-way.

open road density: Calculated by converting the acres within the allocation of a contiguous block into square miles (total acres/640 acres) and then dividing that figure into the linear measure of open roads within the block. Open roads forming the boundary of a contiguous management prescription block contribute half of their length to open road density calculations. An open road is a motorized travelway (including designated motorized trails) used on a regular basis.

operating plan: A written plan, prepared by those engaged in mining activity on the forests, and approved by a forest officer for prospecting, exploration, or extraction activities that are slated to take place on National Forest System land.

ordinary high water mark: The line on the shore established by the fluctuation of water, and is indicated by physical characteristics including a clear, natural line impressed on the bank; shelving, changes in the character of soil, destruction of terrestrial vegetation, the presence of litter, debris, or other appropriate means that consider the characteristics of the surrounding area.

output: The goods, end products, or services that are purchased, consumed, or used directly by people. Goods, services, products, and concerns produced by activities that are measurable and capable of being used to determine the effectiveness of programs and activities in meeting objectives. A broad term for describing any result, product, or service that a process or activity actually produces.

output, minimum level: The amount of an output that will occur regardless of management activity.

outstanding mineral rights: Instances in which the minerals in federally: owned lands were severed prior to the transaction in which government acquired the land. Such rights are not subject to the Secretary of Agriculture's rules and regulations. Removal or extraction of these minerals must be allowed in accordance with the instrument severing the minerals from the surface and under applicable state and local laws and regulations. See also Reserved Mineral Right.

outstandingly remarkable values (ORV): Those scenic, recreational, geological, fish and wildlife, historical, cultural, or other similar values that exist to an outstandingly remarkable degree such that a segment of river qualifies under the Wild and Scenic River Act.

overnight use developed sites (OUDS): National Forest sites with facilities for overnight use, including campgrounds, cabins/fire lookouts, lodges, horse camps, etc. Recreation residences are not included in this definition.

overstory: That portion of trees in a two: or multi-layered forest stand that provides the upper crown cover.

overstory removal: The cutting of trees comprising an upper canopy layer in order to release trees or other vegetation in an understory.

P

partial retention: A visual quality objective which in human activities may be evident, but must remain subordinate to the characteristic landscape.

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.

payments in lieu of taxes: Payments to local or state governments based on ownership of federal land, and not directly dependent on production of outputs or receipt sharing.

perennial stream: Any watercourse that generally flows most of the year in a well-defined channel and is below the water table. Droughts and other precipitation patterns may influence the actual duration of flow. It contains fish or aquatic insects that have larvae with multi-year life cycles. Water-dependent vegetation is typically associated with perennial streams.

personal use: The use of a forest product, such as firewood, for home use as opposed to commercial use or sale.

persons at one time (PAOT): a measure of 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.

person-year: About 2,000 working hours that may be filled by one person working during the course of one year or several people working a total of 2,000 hours.

petrographic: The description and systematic classification of rocks.

physiographic region: A region of similar geologic structure and climate that has had a unified geomorphic history.

planning area: The area of the National Forest System covered by a regional guide or forest plan.

planning criteria: Standards, tests, rules, and guidelines by which the planning process is conducted, and upon which judgments and decisions are based.

DEFINITIONS

PLANNING HORIZON

PRODUCTIVITY

planning horizon: The overall time period considered in the planning process that spans all activities covered in the analysis or plan. All future conditions and effects of proposed actions which would influence the planning decisions.

planning period: One decade. The time interval within the planning horizon that is used to show incremental changes in yields, costs, effects, and benefits.

potential natural vegetation: the biotic community that would become established if all successional sequences were completed without additional human interference under the present environmental conditions. Classifications of Potential Natural Vegetation are based on existing vegetation, successional relationships, and environmental factors (e.g., climate, geology, soil, natural disturbances, etc.) considered together.

pre-commercial thinning: The selective felling, deadening, or removal of tree in a young stand not for immediate financial return, but primarily to accelerate diameter increment on the remaining stems. To maintain a specific stocking or stand density range, or to improve the vigor and quality of the remaining trees.

prescribed fire: Any fire ignited by management actions to meet specific objectives including disposal of fuels, and controlling unwanted vegetation. The fires are conducted in accordance with prescribed fire plans, and are also designed to stimulate grasses, forbs, shrubs, or trees for range, wildlife, recreation, or timber management purposes.

prescribed fire plan: A written statement defining the objectives to be attained as well as the conditions of temperature, humidity, wind direction and speed, fuel moisture and soil moisture under which a prescribed fire will be allowed to burn.

present net value (PNV): The difference between the discounted value (benefits) of all outputs to which monetary values or established market prices are assigned and the total discounted costs of managing the planning area. Future estimated revenues and costs are ‘discounted’ to the present by an interest rate that reflects the changing value of a dollar over time. Also called present net worth and net present value.

preservation: A visual quality objective that provides for ecological change only.

presuppression: Activities required in advance of fire occurrence to ensure effective suppression action, including: (1) recruiting and training fire forces, (2) planning and organizing attack methods, (3) procuring and maintaining fire equipment, and (4) maintaining structural improvements necessary for the fire program.

primary trout stream: Streams that contain naturally-reproducing populations of brook, rainbow, and/or brown trout.

primitive road: Roads constructed with no regard for grade control or designed drainage, sometimes by merely repeated driving over an area. These roads are single lane, usually with native surfacing and sometimes passable with four-wheel drive vehicles only, especially in wet weather.

process records: A system that records decisions and activities that result from the process of developing a forest plan, revision, or significant amendment.

proclamation boundary: The boundary contained within the presidential proclamation that established the national forest.

productivity class: A classification of the capacity of a given piece of land for timber growth is expressed in cubic feet per acre a year.

Class I: Lands capable of producing 120 cubic feet or more per acre a year.

Class II: Lands capable of producing 85 to 119 cubic feet per acre a year.

Class III: Lands capable of producing 50 to 84 cubic feet per acre a year.

Class IV: Lands capable of producing 20 to 49 cubic feet per acre a year.

program budget: The schedule of projects and activities to be carried out on the forest for a year for which funds have been appropriated.

program development and budgeting: The process by which activities for the forest are proposed and funded.

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.

proposed wilderness study area: Areas recommended for wilderness study by the Forest Service but which have yet to be acted on by Congress.

pulpwood: Wood cut and prepared primarily for manufacture into wood pulp.

R

range allotment: A designated area of land available for livestock grazing upon which a specified number and kind of livestock may be grazed under a range.

range management: The art and science of planning and directing range use to obtain sustained maximum animal production, consistent with perpetuation of the natural resources.

ranger district: Administrative subdivisions of the forest supervised by a District Ranger who reports to the Forest Supervisor.

real dollar value: A monetary value, which compensates for the effects of inflation.

receipt shares: The portion of receipts derived from Forest Service resource management that is distributed to state and county governments, including the Forest Service, 25 percent fund payments.

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.

Record of Decision: A document separate from, but associated with an environmental impact statement that publicly and officially discloses the responsible official's decision on the alternative assessed in the environmental impact statement chosen to implement.

DEFINITIONS

RECREATION

RECREATION OPPORTUNITY SPECTRUM

recreation: Leisure time activity including swimming, picnicking, camping, boating, hiking, hunting, and fishing.

Recreation Opportunity Spectrum (ROS): A method for classifying types of recreation experiences available, or for specifying recreation experience objectives desired in certain areas. Classes include:

Primitive (P): An area characterized by having essentially unmodified natural environment of 5,000 or more acres. Interaction between users is very low and evidence of other users is minimal. The area is managed to be essentially free from evidence of human-induced restrictions and controls. Motorized use within the area is not permitted. There is a high probability of experiencing isolation from the sights and sounds of humans, independence, closeness to nature, tranquility, and self-reliance through the application of outdoor skills in an environment that offers a high degree of challenge and risk.

Semi-Primitive Non-Motorized (SPNM): Area characterized by a predominantly natural or natural-appearing environment of 2,500 or more acres. Interaction between users is low, but there is often evidence of other users. The area is managed in such a way that minimum on-site controls and restrictions may be present but are subtle. Motorized use is not permitted. There is a moderately high probability of experiencing isolation from the sights and sounds of humans, independence, closeness to nature, tranquility, and self-reliance through the application of woodsman and outdoor skills in an environment that offers challenge and risk.

Semi-Primitive Motorized (SPM): Area characterized by a predominantly natural or natural-appearing environment of 2,500 or more acres, with a moderately high probability of experiencing isolation from the sights and sounds of humans, independence, closeness to nature, tranquility, and self-reliance through the application of woodsman and outdoor skills in an environment that offers challenge and risk. Motorized use is permitted.

Roaded Natural (RN): Area characterized by a predominantly natural or natural-appearing environment with a low probability of experiencing isolation from the sights and sounds of man. Interaction between users may be low to moderate, but with evidence of other users prevalent. Conventional motorized use is provided for in construction standards and design of facilities. Opportunities for both motorized and non-motorized forms of recreation may be provided.

Rural (R): Area characterized by a substantially modified natural environment with a low probability of experiencing isolation from the sights and sounds of man. A considerable number of facilities are designed for use by a large number of people. Facilities for intensified motorized use and parking are provided.

Urban (U): Area characterized by a substantially urbanized environment, although the background may have natural-appearing elements. Vegetative cover is often manicured. Sights and sounds of humans, on-site, are predominant. Facilities for highly intensified motorized use and parking are available with forms of mass transit often available to carry people throughout the site.

Semi-Primitive (SP): Not a true recreation opportunity class, Semi-Primitive is an abbreviated consolidation of both the Semi-Primitive Non-Motorized and Semi-Primitive Motorized classes.

Semi-Primitive 2 (SP2): Not a true recreation opportunity class. Semi-Primitive 2 areas surround and buffer SPNM or SPM areas on the Jefferson National Forest. They occur within a half mile of an open road but new permanent roads are prohibited. Interaction between visitors is low, but with evidence of other users prevalent. There is a low probability of experiencing isolation from the sights and sounds of man. Opportunities for both motorized and non-motorized forms of recreation may be provided.

DEFINITIONS

RECREATION VISIT

RESOURCE

recreation visit: The entry of one person upon a National Forest to participate in recreation activities for an unspecified period of time. A NF visit can be composed of multiple site visits.

recreation visitor day (RVD): A unit of measure of recreation use equivalent to 12 hours of accumulated recreational activity by one or more persons during one or more visits to the National Forest. For example, 1 person for 12 hours, 2 persons for 6 hours, 3 persons for 4 hours are each one RVD.

regeneration: The re-establishment of forest cover by seeding, planting, and natural means (also called reforestation). Also used as a noun referring to the young trees themselves.

regeneration cutting: Any removal of trees intended to assist regeneration already present or to make regeneration possible.

regeneration method: Cutting procedure by which a new age class is created. Major methods are clearcutting, seed-tree, shelterwood, selection, and coppice.

regeneration period: The time between the initial regeneration cutting and the successful re-establishment of a new age class by natural means, planting, or direct seeding.

Region 8: The states that make up the Southern Region of the USDA Forest Service.

Regional Forester: The official responsible for management of National Forest land within a USDA Forest Service region.

regulated harvest: Includes any volume scheduled in calculations of the allowable sale quantity which is harvested from suitable forest land.

release and weeding: A silvicultural treatment designed to free desirable trees from competition with overstory trees, less desirable trees, or grasses and other forms of vegetative growth. It includes release of natural and artificial regeneration.

removal cut: The cut which removes the last seed bearers of a seed tree or shelterwood regeneration method after the new seedling stand is considered to be established.

research natural area: An area set aside by the Forest Service specifically to preserve a representative sample of an ecological community, primarily for scientific and educational purposes. Commercial exploitation is not allowed and general public use is discouraged.

reserve trees: Trees, pole-sized or larger, retained after the regeneration period under the clearcutting, seed-tree, shelterwood, or coppice methods.

reserved mineral rights: Refers to those cases wherein the minerals were severed from the surface during the transaction whereby the government acquired the land. These rights are subject to the Secretary of Agriculture’s rules and regulations that were applicable at the time of the transaction.

residual trees: The live trees remaining after a natural or artificial disturbance (e.g. a wind event or timber harvest).

resource: An aspect of human environment which renders possible, or facilitates the satisfaction of, human wants, and the attainment of social objectives.

DEFINITIONS

RESOURCE ALLOCATION MODEL

RIPARIAN-DEPENDENT

resource allocation model: A mathematical model using linear programming that will allocate land to prescriptions and schedule implementation of those prescriptions simultaneously. The end purpose of the model is to find a schedule and allocation that meets the goals of the forest and optimizes some objective function including minimizing costs. The model used for this planning is called Spectrum.

resource use and development opportunities: A possible action, measure, or treatment and corresponding goods and services identified and introduced during the scoping process. It may subsequently be incorporated into and addressed by the land and resource management plan in terms of a management prescription.

responsible line officer: The Forest Service employee who has the authority to select and/or carry out a specific planning action.

restoration: The process of modifying an ecosystem or repairing damage, such that natural processes will again function in the repaired system to achieve a desired, healthy and functioning condition.

retention: A visual quality objective in which human activities are not evident to the casual forest visitor.

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.

right-of-way: A right of use across the lands of others. It generally does not apply to absolute purchase of ownership. Land authorized to be used or occupied for the construction, operation, maintenance, and termination of a project or facility passing over, upon, under, or through such land.

riparian: Land areas directly influenced by water. They usually have visible vegetative or physical characteristics showing this water influence. Streamside, lake borders, and marshes are typical riparian areas.

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-associated species: Species that may use a variety of habitats but that disproportionately make use of aquatic or riparian areas during at least one stage of their life cycle.

riparian corridor: An administrative zone applied to both sides of a stream or along side a pond, lake, or wetland. It is a fixed width that may fall within or beyond the true riparian area.

riparian-dependent species: Species that are dependant on riparian areas during at least one stage of their life cycle.

DEFINITIONS

RIPARIAN FUNCTIONS

RPA PROGRAM

riparian functions: Activities that occur in a riparian area without the influence of management activities. Functions include erosion and deposition by the streams, nutrient cycling, movement and storage of water, vegetative succession, etc.

ripping: A process where the soil is mechanically sliced or broken to improve tilth, aeration, and permeability.

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 closure: A technique used by management to regulate and control the use of facilities to achieve transportation economy, user safety, protection of the public investment, and accomplishment of forest resource objectives. It may be intermittent or long term.

road construction: Activity that results in the addition of forest system or temporary road miles.

road density: See open road density.

road maintenance levels: A formally established set of objectives that describes the conditions necessary to achieve the planned operation of a road. The levels vary from Level I, basic custodial care, to Level V, which is assigned high use roads in which user safety and comfort are important considerations.

road reconstruction: Activity that results in improvement or realignment of an existing system road defined as follows:

> road improvement: Activity that results in an increase of an existing road's traffic service level, expansion of its capacity, or a change in its original design function.
>
> road realignment: Activity that results in a new location of an existing road or portions of an existing road, and treatment of the old roadway.

roadless area: National Forest lands evaluated for potential wilderness that meet the criteria in FSH 1909.12, Chapter 7.

Roadless Area Review and Evaluation (RARE) II: The assessment of "primitive" areas within the national forests as potential wilderness areas as required by the Wilderness Act. This refers to the second such assessment that was documented in the final environmental impact statement of the Roadless Area Review and Evaluation, January 1979.

roads analysis process (RAP): Roads analysis is an integrated ecological, social, and economic science based approach to transportation planning that addresses existing and future road management options. The intended effects are to ensure that decisions to construct, reconstruct, or decommission roads will be better informed by using a roads analysis. Roads analysis may be completed at a variety of different scales, but generally begins with a broad forest-scale analysis to provide a context for future analyses.

rotation: The number of years required to establish, including the regeneration period and grow timber crops, to a specified condition or maturity for harvest. Even: and two-aged management prescriptions in the Forest Plan use a rotation.

roundwood: Timber and fuelwood prepared in the round state: from felled trees to material trimmed, barked, and crosscut (e.g.: logs and transmission poles).

RPA Program: The recommended direction for long-range management of renewable resources of National Forest System lands. This direction serves as the basis for the regional targets assigned to the forest. The development of this direction is required by the Forest and Rangeland Renewable Resources Planning Act.

runoff: The total stream discharge of water from a watershed including surface and subsurface flow, but not groundwater. Usually expressed in acre-feet.

rural: A recreation opportunity spectrum classification for areas characterized by a substantially modified natural environment. Sights and sounds of man are evident. Renewable resource modification and utilization practices enhance specific recreation activities or provide soil and vegetative cover protection.

rural water use: Term used in previous water-use circulars to describe water used in suburban or farm areas for domestic and livestock needs. The water is generally self-supplied.

S

sacred sites: Any specific, discrete, narrowly delineated location on Federal land that is identified by an Indian tribe, or Indian individual determined to be an appropriately authoritative representative of an Indian religion, as sacred by virtue of its established religious significance to, or ceremonial use by, an Indian religion; provided that the tribe or appropriately authoritative representative of an Indian religion had informed the agency of the existence of such a site.

sale schedule: The quantity of timber planned for sale by time period from an area of suitable land covered by a forest plan. The first period (usually a decade) of the selected sale schedule provides the allowable sale quantity. Future periods are shown to establish that long-term sustained yield will be achieved and maintained.

salmonids: Fish of the family salmon idea, the chars, trouts, salmons, and white fishes.

salvage cutting: The removal of dead trees or trees being damaged or killed by injurious agents other than competition. To recover value that would otherwise be lost.

sanitation cutting: The removal of trees to improve stand health and to reduce actual or anticipated spread of insects and disease.

sapling: A usually young tree that is larger than a seedling, but smaller than a pole. Size varies by region.

sawtimber: Trees suitable in size and quality for producing logs that can be processed into dimension lumber.

scalloping: The undulating vegetative edge treatment given to a travelway or opening for aesthetic purposes.

scenic attractiveness: The scenic importance of a landscape based on human perceptions of the intrinsic beauty of landform, rockform, waterform, and vegetation pattern. Classified as A (Distinctive), B (Typical or Common), or C (Undistinguished).

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).

DEFINITIONS

SCENERY MANAGEMENT SYSTEM

SELECTION CUTTING

Scenery Management System (SMS): 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 Agricultural Handbook #462.

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 condition.

scenic integrity objective (SIO): A desired level of excellence based on physical and sociological characteristics of an area. Refers to the degree of acceptable alterations to the valued attributes of the characteristic landscape. Objectives include Very High, High, Moderate, and Low.

Very High (VH): Generally provides for only for 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 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.

scoured channel: A definable channel of flow where surface water converges with enough energy to remove soil, organic matter, and leaf litter.

secondary processor: A mill that processes partially manufactured wood (a wood product such as chips or lumber), into a finished product. Examples include paper and furniture.

secondary trout streams: Streams that do not contain naturally-reproducing trout populations, but will sustain trout throughout the year. Populations must be maintained by stocking.

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.

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, and to produce a new age class in a fully-exposed microenvironment.

seed-tree with reserves method: A two-aged regeneration method in which some or all of the seed trees are retained after regeneration has become established to attain goals other than regeneration.

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 are accomplished at each cutting cycle.

semi-primitive: See Recreation Opportunity Spectrum

sensitive species: Those species that are placed on a list by the Regional Forester for which population viability is a concern.

sensitivity analysis: A determination of the consequences of varying the level of one or several factors while holding other factors constant.

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 overwood.

shelterwood with reserves: A two-aged regeneration method in which some or all of the shelter trees are retained, well beyond the normal period of retention, to attain goals other than regeneration.

short-term effects: In planning, those effects that usually occur within ten years.

short-term facilities: Facilities developed and operated for limited resource activity or other project needs. It will cease to exist as a transportation facility after the purpose for which it was constructed is completed, and the occupied land is reclaimed and managed for natural resource purposes.

silvicultural system: A management process whereby forests are tended, harvested, and replaced, resulting in a forest of distinctive form. Systems are classified according to the method of carrying out the fellings that remove the mature crop, and provide for regeneration and according to the type of forest thereby produced.

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 regeneration method of creating new age classes in uneven-aged stands in which individual trees of all size classes are removed uniformly throughout the stand to achieve desired stand structural characteristics.

site class: A classification of site quality, usually expressed in terms of ranges of dominant tree height at a given age or potential mean annual increment at culmination.

site preparation: The preparation of the ground surface prior to reforestation. Various treatments are applied as needed to control vegetation that will interfere with the establishment of the new crop of trees or to expose the mineral soil sufficiently for the establishment of the species to be reproduced.

site index: A series-specific measure of actual or potential forest productivity (site quality, usually for even-aged stands), expressed in terms of the average height of trees included in a specified stand component (defined as a certain number of dominants, codominants, or the largest and tallest trees per unit area) at a specified index or base age.

site productivity class: A species-specific classification of forest land in terms of inherent capacity to grow crops of industrial, commercial wood. Usually derived from the site index.

site quality (productivity): The productive capacity of a site, usually expressed as volume production of a given species.

skid road: A temporary blade-constructed pathway having a road-like function and appearance, used to drag felled trees or logs to a landing. Several skid trails normally branch off of a skid road.

skid trail: A temporary pathway through the woods formed by loggers dragging (skidding) logs from the stump to a log landing or skid road, without dropping a blade and without purposefully changing the geometric configuration of the ground over which they travel.

skidding: A term for moving logs by dragging from stump to roadside, deck, or other landing.

slash: The residue left on the ground after felling, silvicultural operations, or as a result of storm, fire, girdling, or poisoning. All vegetative debris resulting from the purchaser's operations. Slash associated with construction of roads is subject to treatment according to construction specifications, all other is subject to the terms of contract provision B/BT6.7.

slow-the-spread: A strategy developed to slow the expansion of the generally infested area from gypsy moths.

snag: A dead or partially dead (more than 50 percent) hardwood or pine tree which is used by many species for perching, feeding, or nesting.

social analysis: An analysis of the social (as distinct from the economic and environmental) effects of a given plan or proposal for action. It includes identification and evaluation of all pertinent desirable and undesirable consequences to all segments of society, stated in some comparable quantitative terms, including persons or percent of population in each affected social segment. In addition, social analysis also includes a subjective analysis of social factors not expressible in quantitative terms.

soil enhancement: Application of methods or materials to the soil to increase its productivity and stimulate growth of vegetation.

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.

soil and water resource improvement: The application of preplanned treatment measures designed to favorably change conditions of water flow, water quality, rates of soil ero-

DEFINITIONS

sion, and enhancement of soil productivity.

SOUTHERN PINE BEETLE

southern pine beetle: One of the many species of pine bark beetles that are present in the forest at all times. When environmental and forest conditions become favorable, the beetle populations can increase and cause substantial timber losses over extensive areas in a relatively short period of time.

SUCCESSIONAL STAGE

special places: Those specific locations and expanses in outdoor settings that have attractions and features that are identified as unique, different, distinctive, and extraordinary to people. Special places can range in size from small areas to very large areas.

special use authorization: A permit, term permit, or easement that allows occupancy, use, rights, or privileges of National Forest System land.

SPECTRUM: A computer modeling tool to model alternative resource management scenarios applied to landscapes through time in support of strategic and tactical planning. This includes scheduling vegetation manipulation activities to achieve ecosystem management objectives; modeling resource effects and interactions within management scenarios; and exploring tradeoffs between alternative management scenarios in support of decision-making.

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: A contiguous group of trees sufficiently uniform in age-class distribution, composition, and structure, and growing on a site of sufficiently uniform quality, to be a distinguishable unit.

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.

stand improvement: A term comprising all intermediate cuttings made to improve the composition, structure, condition, health, and growth of even-aged, two-aged, or uneven-aged stands.

standard: Requirement that precludes or imposes limitations on resource management practices and uses. Usually for resource protection, public safety, or addressing an issue.

stocking: The degree of occupancy of land by growing stock trees, measured by basal area or number of trees per unit area and spacing compared with a minimum standard: which varies by tree size and species or species group: to the occupancy that is required to fully utilize the growth potential of the land.

stratigraphic: Pertaining to strata or layers, as in a description of layers of rock types.

stratum (canopy layer): A distinct layer of vegetation within a forest community.

stressors: Pressure or change brought upon an ecosystem by pollution sources including sediment, contaminants, and toxins.

successional stage: A period, marked by distinctiveness of structure, in the development of a forest community from establishment of tree regeneration to advanced age.

Forest age is used as a surrogate measure of the distinct structure at each stage as follows: early 0-10 years; seedling/sapling 11-40 years; mid 41-80 years; and late over 80 years old.

SUITABLE TIMBER PRODUCTION

suitable for timber production: National Forest System land allocated by a Forest Plan decision to be managed for timber production on a regulated basis. *Regulated basis* means a systematic relationship between tree growth and timber harvest such that a specific timber volume objective level can be sustained indefinitely.

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.

supply: The amount of a good or service that producers are willing to provide at a specified price, time period, and conditions of sale.

surface use plan of operation: In minerals management, a plan for surface use, disturbance and reclamation on a leasehold.

surficial water: Water on or at the ground surface. Does not include ditches, canals, spillways, or other human-created flow channels.

sustained yield of the products and services: The achievement and maintenance in perpetuity of a high-level annual or regular periodic output of the various renewable resources of the National Forest System without impairment of the productivity of the land.

sympatric: Condition where two or more closely related species live together n the same section of stream. The species have overlapping distributions. Opposite of allopatric.

T

temporary road: A road authorized by contract, permit, 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.

thinning: A cutting made to reduce stand density of trees primarily to improve growth, enhance forest health, or to recover potential mortality.

thinning interval: The period of time between successive thinning entries, usually used in connection with even-aged stands.

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 demand: A relationship between stumpage or delivered log price and the quantity of timber produced.

timber product market area: The geographic area enclosed within a polygon drawn by connecting those mills buying forest timber that are the farthest away from the forest.

timber production: The purposeful growing, tending, harvesting, and regeneration of regulated crops of trees to be cut into logs, bolts, or other round sections for industrial or consumer use. For purposes of forest planning, timber production does not include the production of fuelwood or harvests from unsuitable lands. (36 CFR 219.3, 1982 rule)

timber removals (drain): The merchantable volume of trees removed from the inventory by harvesting, cultural operations including stand improvement, land clearing, or changes in land use expressed as an annual average between surveys. Within national forests, removals are almost all timber harvest except that the inventory on lands withdrawn by legislative action is also normally accounted for as "removals."

timber sale program quantity (TSP): The volume of timber planned for sale during the first decade of the planning horizon. It includes the allowable sale quantity (chargeable volume), and any additional material (non-chargeable volume), planned for sale. The timber sale program quantity is usually expressed as an annual average for the first decade.

timber stand improvement: A term comprising all intermediate cuttings made to improve the composition, constitution, condition, and increment of a timber stand.

timber supply: The amount of wood raw material available to be harvested within specified parameters of time and geographic area.

timberland: Forest land that is producing or capable of producing in excess of 20 cubic feet per acre per year of industrial wood crops under natural conditions. Not withdrawn from timber utilization, and not associated with urban or rural development. Currently, inaccessible and inoperable areas are included.

tolerance: The ability of a tree to grow satisfactorily in the shade of, and in competition with, other trees.

topography: The configuration of a land surface including its relief, elevation, and the position of its natural and human-made features.

toxicity index profile: Estimate of cumulative potential for toxic impacts in water.

traditional cultural property: A historic property that is eligible for inclusion in the National Register because of its association with cultural practices or beliefs of a living community that (a) are rooted in that community's history, and (b) are important in maintaining the continuing cultural identity of the community.

trailheads: The parking, signing, and other facilities available at the terminus of a trail.

traffic service levels: Describe a road's significant traffic characteristics and operating conditions.

two-aged silvicultural system: A planned sequence of treatments designed to maintain and regenerate a stand with two age classes.

two-aged stand: A stand composed of two distinct age classes that are separated in age by more than 20 percent of rotation.

U

unacceptable alteration: A scenic integrity level (never an objective) where human activities of vegetative and landform alterations are excessive and totally dominate the natural, natural-appearing or valued cultural landscape character.

understory: The trees and other vegetation growing under a more or less continuous cover of branches and foliage formed collectively by the upper portion (overstory) of adjacent trees and other woody growth.

uneven-aged regeneration methods: Methods of regenerating a forest stand, and maintaining an uneven-aged structure by removing some trees in all size classes either singly, in small groups, or strips. The methods are single-tree or group selection.

uneven-aged silvicultural system: A planned sequence of treatments designed to maintain and regenerate a stand with three or more age classes.

universal soil loss equation: An equation used to estimate soil erosion rates and for the design of water erosion control systems. A = RKLSPC wherein A = average annual soil loss in tons per acre per year; R = rainfall factor; K = soil erodibility factor, L = length of slope; S = percent of slope; P = conservation practice factor; and C = cropping and management factor.

unregulated forest: Commercial forest land that will not be organized for timber production under sustained-yield principles.

utilization standards: Measurements for standing trees that describe the minimum size tree that will be designated for sale for various products including sawtimber or small roundwood.

V

values, market: Prices of market goods and services measured in real dollars in terms of what people are willing to pay as evidenced by market transactions.

values, non-market: Prices of non-market goods and services imputed from other economic values.

vertical diversity: The diversity in a stand that results from the different layers or tiers of vegetation.

very low scenic integrity (VL): An existing scenic inventory classification in which landscapes appear heavily altered. Human created deviations may strongly dominate the valued landscape character. They may not borrow from valued attributes of size, shape, edge effect, and pattern of natural openings, vegetative type changes, or architectural styles within or outside the landscape being viewed. However, deviations must be shaped and blended with the natural terrain so that elements such as edges, roads, landings, and structures do not dominate the composition.

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.

viewshed: The total landscape seen, or potentially seen from all or a logical part of a travel route, use area, or waterbody.

visual quality objective (VQO): A term under the Visual Management System (VMS) as defined in Agricultural Handbook #462 which was replaced by “scenic integrity objective” under the Scenery Management System (SMS). A desired level of excellence based on physical and sociological characteristics of an area under the Visual Management System. Refers to the degree of acceptable alterations of the characteristic landscape. Objectives include Preservation, Retention, Partial Retention, Modification, and Maximum Modification. Except for "preservation," each goal describes a different degree of acceptable alteration of the natural landscape based on the importance of aesthetics.

visual resource: The composite of basic terrain, geological features, water features, vegetative patterns, and land-use effects that typify a land unit and influence the visual appeal the unit may have for visitors.

W

warm water fishery: Aquatic habitats that support fish species which have their best reproductive success and summer water temperature tolerance between 75 and 85 degrees Fahrenheit (23-29 C), or about 80 degrees Fahrenheit. Examples include sunfish species, and largemouth bass.

water supply area: Areas that serve present and future municipal water supply and trout hatching or rearing operations.

water yield: The measured output of the forest's streams expressed in acre-feet. The amount or volume of water that flows in a given period of time from a watershed.

waterbars: A change in the grade of a roadbed, trail surface, or fire line used to divert water off the surface to prevent it from eroding ruts and possibly carrying sediment to a stream.

watershed: The total area above a given point on a stream that contributes water to the flow at that point.

wetlands: Pursuant to the Federal Clean Water Act: areas that are inundated or saturated by surface or ground water at a frequency and duration sufficient to support, and that under normal circumstances, support a prevalence of vegetation typically adapted for life in saturated soil conditions. Wetlands generally include swamps, marshes, bogs and similar areas, and are found primarily within palustrine systems; but may also be within riverine, lacustrine, estruarine, and marine systems.

wild and scenic river: A river or section of river designated as such by congressional action under the Wild and Scenic Rivers Act of Oct. 2, 1968, as supplemented and amended, or those sections of a river designated as wild, scenic, or recreational by an act of the legislature of the state or states through which it flows. A river can be classified under the following three categories:

> wild river: Free of impoundments and generally inaccessible except by trail, and within watersheds or shorelines that are essentially primitive.
>
> scenic river: Free of impoundments but accessible by roads, and within watersheds or shorelines that are still largely primitive and undeveloped.
>
> recreational river: Readily accessible by roads, with some development along their shorelines and may have undergone some impoundment or diversion in the past.

wilderness study area: One of the areas selected by the Chief of the Forest Service from an inventory of undeveloped National Forest System lands as having apparent high qualities for wilderness. Lands possessing the basic characteristics of wilderness and designated by Congress for further wilderness study. A study can determine whether they should be recommended for addition to the National Wilderness Preservation System.

wildland fire: Any non-structural fire on wildlands other than one intentionally set for management purposes. Confined to a predetermined area. Not to be confused with "fire use", which includes prescribed fire.

wildland fire use: The use of a wildland fire to attain planned fire treatment and resource management objectives, therefore not requiring a suppression response.

wildland urban interface: The line, area, or zone where structures and other human development meet or intermingle with undeveloped wildland or vegetative fuels.

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 and fish user-day (WFUD): A 12-hour participation in the use of wildlife and fish primarily for consumptive or non-consumptive use including hunting, fishing, or wildlife viewing. Such use is the result of habitat management, and the populations supported by that habitat. A WFUD is counted as one day or any part of a day that the user participated in these activities. Does not include sport or commercial uses of anadromous fish.

wildlife habitat diversity: The distribution and abundance of different plant and animal communities and species within a specific area.

wildlife habitat improvement: The manipulation or maintenance of vegetation to yield desired results in terms of habitat suitable for designated wildlife species or groups of species.

wildlife tree: A den tree, snag, or mast or food tree.

with-without comparison: An evaluation that compares outputs, benefits, costs, and other effects with a base alternative.

withdrawn national forest lands: National Forest System lands segregated or otherwise withheld from settlement, sale, location, or entry under some or all of the general land laws.

X

xeric: Pertaining to sites or habitats characterized by decidedly dry conditions.

Y

yarding: A term used to describe operations used to move logs from stump to point where logs are loaded for transport to mill. Most commonly used in cable logging operations.

yield table: A tabular statement of outputs expected to be produced under a specific set of conditions.

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