Chapter 1 -- Purpose and Need

Introduction

In compliance with the National Environmental Policy Act (NEPA) and other relevant State and Federal laws and regulations, the USDA Forest Service has prepared this Environmental Impact Statement (EIS) on the potential effects of silvicultural and ecological research in the Fernow Experimental Forest. This document provides information on research projects proposed for implementation in the Fernow Experimental Forest (FEF) over the next several years.

This EIS discloses the direct, indirect and cumulative environmental impacts and any irreversible or irretrievable commitment of resources that would result from the proposed action and alternatives. It is prepared according to the format established by the Council on Environmental Quality (CEQ) regulations for implementing the NEPA (40 CFR 1500-1508). Chapter 1, in addition to explaining the purpose and need for the proposed actions, discusses the relationship of the proposed actions to various planning documents, and identifies the significant issues driving the DEIS analysis. Chapter 2 describes the proposed actions, alternatives to the proposed actions, and compares these. Chapter 3 describes the physical, biological, and social environments that could be potentially affected by the proposed actions and alternatives. It also discloses the environmental effects of each of the alternatives being considered. Chapter 4 contains tables and figures, the list of preparers, the DEIS distribution list, literature cited, a glossary, a list of scientific and common names of plants and animals found on the FEF and an index. The Appendix provides more detailed information to support the analyses, and contains a summary of comments received during the scoping period. All documents incorporated by reference are available at the Timber and Watershed Laboratory in Parsons, WV.

The interdisciplinary team used a systematic approach to analyze the proposed action and alternatives to it, estimate the environmental effects and prepare this EIS. The planning process complies with NEPA and CEQ regulations. Planning was coordinated with the appropriate Federal, state and local agencies.

Project Area

The 4615-acre FEF is located south of Parsons, WV, and is administered by the Northeastern Research Station of the USDA Forest Service (Figure 1-1). The ecological land type of the FEF Experimental Forest is referred to as the Allegheny Mountains Section of the Central Appalachian Broadleaf Forest (M221) according to the Forest Service National Hierarchical Framework of Ecological Units (McNab and Avers 1994). The landtype association has been designated as the Allegheny Front Side slopes (Ba10) (DeMeo et al. 1995). Braun (1950) classified vegetation as “mixed mesophytic type”. Characteristic tree species include, but are not limited to northern red oak, yellow-poplar, black cherry, sugar maple, bitternut hickory, black birch, red maple, and American beech. The topography is mountainous with elevations ranging from 1750 to 3650 ft above sea

level. Mean annual precipitation is about 58 inches and is distributed evenly throughout the year. The growing season is approximately from May through October with an average frost-free period of 145 days.

Slopes ranging from 20 to 50 percent cover most of the area. The soils are predominantly from the Calvin and Dekalb soil series. The Calvin series consists of moderately deep, well-drained acidic soils formed in material weathered from interbedded shale, siltstone and sandstone. Dekalb soils also are acidic, deriving from acidic sandstones. Belmont soils formed from weathered limestone, that are less acid than the Calvin and Dekalb, also are found on the FEF.

The Elklick watershed (later to become the majority of the FEF) was initially logged between 1903 and 1911 during the railroad-logging era (Fansler 1962, Trimble 1977). However, many trees were not removed due to insufficient size, undesirable species, or poor form. At that time, sugar maple, American beech, black birch, and the hickories were some of the least desirable species. Additionally, merchantability standards were a function of the distance to the standard gauge railroad. Portions of the FEF were cut more heavily than others. Forest fires may have been an important disturbance agent prior to initial logging and perhaps after logging, although actual documentation of past fires does not exist for the Elklick watershed. Most of the watershed was not farmed and the forest was able to regenerate following the cessation of logging activities. The Federal government purchased the land in 1915 and dedicated it to forest and watershed research in 1933. The FEF was selected because in topography, history of cutting and fires, and variety of forest types and conditions, the area was representative of more than 13 million acres of mountainous forestland in West Virginia and adjacent states. Since that time fire and grazing have been excluded. Chestnut blight was the next major disturbance. First noted in West Virginia as early as 1909 (Brooks 1911), the blight resulted in a 25 percent reduction in standing volume on the experimental forest in the 1930's (Weitzman, 1949). Closed during World War II, silviculture and watershed research began again in 1948 and has continued to date without interruption.

The FEF also incorporates part of the Stonelick Run watershed and the headwaters of the Sugarcamp Run and Canoe Run watersheds. Elklick Run drains into the Black Fork River, and Stonelick, Canoe Run and Sugarcamp Run all drain into the Shavers Fork River. These two rivers join to form the Cheat River just north of Parsons.

Relationship to Planning Documents

The proposed actions are consistent with the Land and Resource Management Plan, Monongahela National Forest (Forest Plan) and the proposed forest plan revision. Projects proposed here also are consistent with the General Plan for the Fernow Experimental Forest (Weitzman 1949), the Research Work Unit Description (RWUD), and individual Study Plans. The RWUD was prepared after consultation with a wide range of customers and is updated approximately every 5 years. Study plans have been reviewed for experimental and statistical rigor by scientists within and outside of the

RWU, and for appropriateness and compliance with Station direction by Northeastern Research Station personnel.

Local administration of the FEF is by RWU NE-4353, "Sustainable Forest Ecosystems in the Central Appalachians," located at the Timber and Watershed Laboratory, Parsons, WV. The mission of this research unit is to explain the role of natural and human-induced factors in the sustainability of central Appalachian forest ecosystems, and to provide guidelines for managing central Appalachian forests for a range of products and benefits while maintaining the productivity and diversity of the soil, water, and forest resources. The RWUD currently lists three major research problems as follows:

> *Problem 1*. Ecologically sound silvicultural alternatives must be developed for intensive management of these forests to provide diverse forest products and to maintain or restore the integrity of ecosystem processes.
>
> *Problem 2*. Basic quantitative information is needed about important ecosystem processes and components and the impacts of both chronic stresses and acute disturbances on these.
>
> *Problem 3*. Tools must be developed which allow us to better assess and/or mitigate soil, water and other resource changes attributable to forest management and associated activities

In addition, this RWU is responsible for managing the FEF for long-term ecological and silvicultural research.

Legislation and Executive Orders Related to this EIS

Shown below is a list of laws pertaining to project-specific planning and environmental analysis on Federal lands.

- National Historic Preservation Act of 1966 (as amended)
- Endangered Species Act of 1973 (as amended)
- Archaeological and Historic Preservation Act
- Wild and Scenic Rivers Act of 1986, amended 1986
- Wilderness Act of 1964
- Clean Air Act of 1963 (as amended)
- National Environmental Policy Act of 1969 (as amended)
- Executive Order 11990-Protection of Wetlands
- Executive Order 11988- Protection of Floodplains

Approximately 960 acres or just greater than 20 percent of the FEF would be affected by this proposal during the next five-year period. The kinds of environmental effects expected from the proposal would include changes in vegetation in both the overstory and understory plant communities. Associated with the proposal would be effects to the following natural resources: soil; water; air; aquatic; wildlife; and, threatened,

endangered, and sensitive species.

A portion of the public would consider this proposal to have significant impacts to the physical, biological, and social environments within the scope of the FEF and the region as a whole. This is based on past projects of a similar nature conducted on the Monongahela National Forest and initial scoping for this proposal.

The effects of the proposal are not likely to compound environmental effects because of the use of mitigation measures, including those covered under the Forest Plan, West Virginia's Best Management Practices (BMPs), and those developed for site specific projects.

Environmental Assessments have been prepared on a yearly basis on the Monongahela National Forest for similar types of projects involving timber harvest. A determination was made that the effects of timber harvesting and connected actions from those projects were not significant.

Monitoring the effects of projects is the nature of the research activities. Impacts to natural resources would be documented as part of scientific studies. This information would help us to better understand the impacts of managing the timber resource and the impacts on other forest values. This information would be used to better describe and disclose the effects of projects in future NEPA documents. In addition, a monitoring plan would be developed to assess impacts to resources identified as issues in this EIS.

What do we want to achieve?

The purpose of the proposed actions is to continue long-term research on the effects of various silvicultural practices on forest productivity, species composition and diversity, wildlife populations and ecosystem processes, and to initiate new research**.** We also are proposing management and maintenance activities intended to ensure the integrity of the FEF for long-term research – these activities include control of invasive exotic plants using herbicides, culvert and road maintenance, among others. The goal of all of the proposed research actions is to improve understanding and management of central Appalachian hardwood forests.

With the exception of a proposed new study, all proposed actions are ongoing research, studies that were designed to last 80 years or more. These data represent some of the most complete, continuous long-term records on ecosystem processes in the world. We want to continue these experiments as designed, and continue to gather information about the effects of various silvicultural practices on forest ecosystems in the central Appalachians. We would use the data to provide information on basic ecosystem processes in managed and nonmanaged forests, on species diversity of plants and animals, and on other ecological parameters.

We also propose to initiate a new research study evaluating our ability to create suitable habitat for Indiana bat. The object of this research is to address, in the short-term, the need for Indiana bat summer habitat, and in the longer term, to create a mosaic of sites where oak regeneration is an eventual surety.

We also want to maintain the integrity of the FEF for long-term research purposes. Management activities include: applying gravel to road surfaces as needed, replacing culverts on skid roads and haul roads as needed, maintaining water bars on skid roads, maintaining ditches and culverts, seeding decks and landings, using herbicides to control the spread of Japanese stiltgrass on approximately 4 acres, and other invasives such as tree-of-heaven on an individual tree basis, as needed. One new landing will be created, and one will be abandoned.

Public Involvement

The CEQ defines scoping as "… an early and open process for determining the scope of issues to be addressed and for identifying the significant issues related to a proposed action" (40 CFR 1501.7). The scoping process was used to invite public participation and collect initial comments. The public was invited to participate in the project in the following ways:

Notice of Intent: A Notice of Intent was published in the *Federal Register* on September 20, 2004, when it was decided that an EIS was to be completed for the project.

Public Mailing: In early August 2004, a letter providing information and seeking public comment (scoping document) was mailed to approximately 100 individuals and groups that had previously shown interest in Forest Service projects in WV. The mailing included Federal agencies, State agencies, county offices and various non-governmental organizations and individuals.

Local news Media: A legal announcement about the project was printed in the September 15 and 22, 2004 editions of the *Parsons Advocate.*

Public Meetings: A public meeting was held at the Timber and Watershed Laboratory in Parsons, WV, on August 25, 2004 to provide information and discuss potential areas of concern and or interest that should be addressed in this project.

Issues

Significant issues for the FEF proposed research activities were identified through public and internal scoping and were used to formulate alternatives. Similar issues were combined into one statement where appropriate. The following issues were determined to be significant and within the scope of the project decision. These issues are also addressed through the Proposed Action and alternatives.

Issue 1 - Threatened, Endangered, and Sensitive Species (TES)

Proposed activities could impact TES species found on the FEF. Site disturbing activities could directly or indirectly affect species or their habitat. Threatened and Endangered species known to occur or that may occur on the FEF include Cheat Mountain salamander, Virginia big-eared bat, Virginia northern flying squirrel, Indiana bat, and running buffalo clover. Numerous sensitive species are also known to occur or may occur on the FEF. Refer to the Threatened, Endangered, and Sensitive Species discussion (3.6 Wildlife Resources) of this EIS and the Biological Assessment for Threatened, Endangered and Sensitive Species on the Fernow Experimental Forest, Tucker County, West Virginia (hereafter referred to as the Biological Assessment or BA) for a complete listing of TES species found in the FEF.

Issue 2 - Sediment Impacts

Proposed activities could affect stream sedimentation, channel morphology, and sediment flow regimes. This could have direct, indirect, and cumulative effects not only to water resources but to other resources in the area as well.

Other concerns raised during scoping were used to help frame the effects discussion or were deemed beyond the scope of this DEIS. All comments and agency responses can be found in the Appendix of this DEIS.

Decisions to be Made

The EIS will evaluate site-specific effects and the issues as related to the proposed action and alternatives. The Responsible Official, RWU NE-4353 Project Leader, will make a decision based on a review of the EIS. In keeping with the mission of the FEF, the Project Leader must decide: Whether to proceed with the proposed action or one of the alternatives. The decision will be documented in a Record of Decision (FSH 1909.15, 27.2).

Chapter 2 – Alternatives

This chapter describes and compares the alternatives considered by the Forest Service for the FEF. It includes a discussion of how alternatives were developed, an overview of mitigation measures, monitoring and other features common to all alternatives, a description of each alternative considered in detail and a comparison of these alternatives focusing on the significant issues. It also identifies Alternative C as the Preferred Alternative. Chapter 2 is intended to represent the alternatives in comparative form, sharply defining the issues and providing a clear basis for choice among options by the decision maker and the public (40 CFR 1502.14).

Some of the information in Chapter 2 is summarized from Chapter 3 "Affected Environment and Environmental Consequences." Chapter 3 discusses the scientific basis for establishing baselines and measuring the potential environmental consequences of each of the alternatives. For a full understanding of the effects of the alternatives, readers will need to consult Chapter 3.

Development of Alternatives

The Proposed Action and each alternative presented in this EIS provide a different response to the significant issues for the FEF research program. Each of these alternatives represents a site-specific proposal developed through intensive interdisciplinary team evaluation. The team used information from the analysis of scoping comments to formulate different alternative approaches. Preliminary analysis and management direction were used to further refine the alternatives described here.

Items Common to All Alternatives

The Forest Service uses many mitigation and preventive measures in the planning and implementation of research activities. The application of these measures begins early in the research design phase of a project. The following items are listed to highlight some of the measures of processes that are common to alternatives; this is not a complete list.

Actions common to all studies:

Wildlife Habitat

Tree felling would be conducted only during the dormant season (October through April).

Tree species to be removed is dependent upon the specific silvicultural prescription. However, no butternut trees would be cut, and hickory trees would be left where possible, without compromising the integrity of the research studies.

Soils and Water Quality

Gravel would be applied to road surfaces as needed. Culverts would be replaced on haul roads and skid roads as needed. Culverts and ditches on all roads would be maintained as needed.

Trees would be felled and winched to the landing using a truck crane or tractor and cable, to minimize soil disturbance. Logs would be skidded using a rubber tired skidder or tractor with a logging arch.

Logging and skidding would not be done when conditions are excessively wet, so as to protect against unnecessary erosion and damage.

After logging is complete, skid roads would be closed, and water control devices such as water bars and dips constructed to control the movement of water.

All logging decks would be reclaimed, limed and seeded with a mixture of clover, rye, timothy, and various grasses to prevent erosion.

All BMPs, as defined by the West Virginia Logging Sediment Control Act of 1992, would be followed during and after logging.

Riparian Habitat

Perennial streams would be protected with a 100 foot-wide vegetative strip. A minimum of 75% crown closure would be maintained. There would be no vehicular traffic or herbicide use in the strip.

Non-perennial streams would be protected with a 50 foot-wide vegetative strip. Within this strip, crown closure generally would be 60%. There would be no vehicular traffic or herbicide use in the strip.

Trees would not be cut from within the stream channel or off the stream banks. Logging equipment is restricted or excluded in this area except at designated stream crossing points.

Heritage Resources

Keeping with standard Forest Service practice, all unevaluated sites will be avoided during project planning or implementation.

Alternatives Considered In Detail

The Proposed Action and two other alternatives are considered in detail. The Alternatives are defined as: Alternative A – No-Action; Alternative B -- Proposed Action; and Alternative C – Management Action. The No-Action Alternative is defined as no experimental logging, burning or fertilizer treatments, and no use of herbicides to control invasive exotic plants at this time; the experimental areas would remain subject to natural

changes only. Alternatives B and C satisfy the Purpose and Need, while still responding to the issues discussed in Chapter 1. Alternative C is the Preferred Alternative. Definitions of technical terms and abbreviations are provided in the Glossary.

Alternative A: No-Action Alternative

CEQ Regulations (40 CFR 1502.14d) require that a "No-Action" alternative be analyzed in every EIS. This alternative represents the existing condition against which all other alternatives are compared. The emphasis of this alternative is to continue existing research studies, however without experimental manipulations. This Alternative does not include addition of any new research studies or allow the use of herbicides to control invasive exotic plant species. Thus, only data collection and monitoring would continue. This would prematurely end important long-term research and seriously impair development of new knowledge.

Alternative B: Proposed Action

The proposed action includes many projects that are repeat treatments in ongoing long-term research studies. Silvicultural treatments which include some level of harvesting would be applied on 492.7 acres (Figure 2-1). Single-tree selection would be applied to 169.8 acres, the diameter-limit method applied to 32.7 acres, patch clearcuts applied to 23.2 acres, the financial rate of return method applied to 189.9 acres, and the shelterwood method applied to 77.1 acres. In addition, prescribed fire would be used in combination with the shelterwood method to promote oak regeneration; an 84.7-ac watershed would be treated with ammonium sulfate fertilizer to induce artificial watershed acidification; and in a new study, 376.1 acres would be treated with a combination of prescribed fire and overstory mortality treatments (herbicides and/or girdling) to enhance Indiana bat summer habitat and oak retention, release and restoration (Figure 2-1).

The studies and compartment details are described below:

Large area comparisons of forest management practices (Study No. 4110-FS-NE-1103-2) was initiated in 1950. The primary objective of this study, also known as "Study 2", is to determine the effects of three uneven-aged silvicultural practices (single-tree selection, diameter-limit, patch clearcuts) on stand growth and yield, replicated two times on three oak site index classes (60, 70, and 80). Another objective is to determine the effects of the different silvicultural practices on species composition and log quality across site quality classes. This research is critical to understanding the effects of current harvesting practices, particularly those used on private land, on long-term sustainability and diversity of central Appalachian hardwood forests, and for developing management guidelines and recommendations for these forests. (Compartments 5B, 7A, 7B, WS5A, 17A, 19A, 20A, 20C; 208.3 acres)

Compartments 5B, WS5A, and 20A (159.8 acres) would be treated with single-tree selection. Four parameters determine which trees are harvested or left in the stand: residual basal area (RBA) in square feet per acre for trees greater than 11 inches in

diameter at breast height (dbh), the target distribution of stems in 2-inch diameter classes referred to as "Q", the largest diameter tree to retain in the stand, and cutting cycle. A Q of 1.3 (i.e., there are 1.3 times more stems in each successively smaller diameter class) is used for all sites. Compartments with site index 60 are assigned the parameter values 35 ft^2/ac RBA, largest retained tree is 20 inches dbh, and 15-yr cutting cycle. Compartments with site index 70 are assigned the parameter values 50 ft^2/ac RBA, largest retained tree is 26 inches dbh, and 10-yr cutting cycle. Compartments with site index 80 are assigned the parameter values 65 ft^2/ac RBA, largest retained tree is 32 inches dbh, and 10-yr cutting cycle.

Compartment 20C (27.7 acres) would be harvested using the diameter-limit method, the most common harvesting method used on nonindustrial private forest land in the eastern United States. All trees with dbh greater than 17 inches will be removed at each cutting cycle. Stands with site index 60 have a 20-yr cutting cycle while site index 70 and 80 stands have a 15-yr cutting cycle.

Compartments 7A, 7B, 17A, and 19A would be treated with a total of 23.2 acres in patch clearcuts. Various numbers of 0.4-ac regeneration openings are created in each compartment to promote uneven-aged stands of even-aged patches. Total acres treated each cycle are determined by compartment size, rotation length, and number of harvests during rotation. Site index 60 stands have a rotation length of 90 years and a 15-yr cutting cycle; $1/6^{th}$ of the stand is treated each cycle. Site index 70 and 80 stands have a rotation length of 80 years and a 10-yr cutting cycle; $1/8^{th}$ of the stand is treated each cycle.

<u>Comparison of four cutting practice levels in Appalachian hardwood forest types</u> (Study No 4110-FS-NE-4101-8) was initiated in 1948. The original objective of this study was to compare "good", "fair', and "poor" cutting practices as they were perceived to be in the late 1940s. The study involved observing the long-term impact of 4 management alternatives (single-tree selection, intensive single-tree selection, diameter-limit harvest, and commercial clearcut) on wood volume production, stand quality and regeneration. More recently, the objectives have been broadened to include quantifying long-term stand dynamics, particularly species composition, and evaluating aesthetics. This study was set up with the four cutting treatments and a control on five 5-acre compartments along the Zero-grade Trail to provide added demonstration value. These are among the oldest forestry research plots in North America and receive many visitors. (Compartments 8B, 8C, 8D; 5 acres each, 15 acres total)

Compartment 8B would be treated using the diameter-limit method. All trees with dbh greater than 15.5 inches will be removed. Compartment 8C would be treated with single-tree selection. Only sawtimber-sized trees, those with dbh of 11 inches or greater, may be removed using the selection parameters of 70 ft^2/ac RBA, Q= 1.3, largest retained tree is 32 inches dbh, and 10-yr cutting cycle. Compartment 8D would be treated with an intensive single-tree selection where trees with dbh of 5 inches or greater may be removed. The selection parameters applied are 85 ft^2/ac RBA, Q 1.3, largest retained tree is 32 inches dbh, and 10-yr cutting cycle.

Financial rate of return areas on the Fernow Experimental Forest (Study No. 4110-FS-NE-4101-62) was initiated in 1971. The objective of this study is to determine the effects of financial rate of return harvests on growth and yield of hardwood stands, species composition and hardwood stand quality. The financial rate of return method is a selection system that uses economic guidelines for selecting trees to harvest in combination with silvicultural criteria such as desired residual stocking of potentially valuable trees and removal of poor quality or high risk (Trimble et al. 1974). The minimum size tree to cut varies by species and is dependent on the desired rate of return; generally, as the desired rate of return decreases, the dbh of trees to retain increases. Two study areas are being utilized for each of the following estimated rates of return: 2, 3, 4 and 6%, as a test of the utility and accuracy of these criteria for selection, and to evaluate the effects on stand characteristics over time. (Compartments 20B, 26A, 26B, 61; 189.9 acres)

Compartment 61 (118.4 acres) would be treated at the 3% financial rate of return, compartment 20B (25.3 acres) would be treated at the 4% rate, and compartments 26A and 26B (46.2 acres) would be treated at the 6% rate.

Evaluating prescribed fire as a silvicultural tool to promote oak regeneration in the central Appalachians (4300-FS-NE-4353-12). The principal objective of this research is to determine the effectiveness of using prescribed fire and fencing in conjunction with a shelterwood regeneration method to regenerate oak. Secondary objectives include evaluating treatment effects on coarse woody debris, forest floor and litter characteristics, seedbank composition and abundance, spring ephemeral wildflowers, herpetofauna, and acorn predation by weevils. The study is intended to develop a silvicultural technique related to the use of prescribed fire, but also will examine changes in ecosystem properties than can be considered at the stand or subwatershed scale. (Compartment R1, 77.1 acres)

The compartments would undergo a spring or fall pre-shelterwood prescribed fire followed by a shelterwood treatment the 2nd winter after burning. The shelterwood treatment would result in approximately 50% residual stocking based on the upland oak stocking guide. The treatment would remove trees in the lower canopy with the goal of creating a predominantly oak overstory. The area would undergo a post-shelterwood prescribed fire 3 growing seasons after harvest.

For all burning studies, the burn plan and prescribed fires would be conducted according to state regulations administered by the West Virginia Division of Forestry. A slow-moving fire (1-5 ft/min) that produces high amounts of heat (2-4 ft flame lengths) would be used. All personnel supervising and working on the fire would be trained in the use of prescribed fire and in fire suppression.

Artificial acidification of several small watersheds at or near the Fernow Experimental Forest (4300-FS-NE-4301-59), and The effect of artificial watershed acidification on vegetation growth and nutrient status. (4300-FS-NE-4301-63).The objectives of this research (also known as the Whole Watershed Acidification Study) are to determine

changes in soil chemistry, soil leachate chemistry, and streamflow chemistry resulting from increased levels of nitrogen and sulfur deposition, and to evaluate the effects of these changes on vegetation growth and ecosystem nutrient status. Ammonium sulfate fertilizer would be applied to a watershed three times per year and the effects on ecosystem parameters would be determined. The study results would quantify the susceptibility of watersheds in the Central Appalachians to acidification by acid deposition. Also, the data would be used to test watershed acidification models. This whole system manipulation approach would quantify the integrated response of a watershed to elevated sulfur and nitrogen loadings. (Compartment WS3; 84.7 acres)

Proposed new research: Prescribed burning and variable intensity overstory mortality for enhanced wildlife habitat structure and long-term oak restoration (Study number yet to be assigned). The objectives of this research are to improve potential Indiana bat summer habitat, and in the longer term, to create a mosaic of sites to promote oak retention, release and restoration. Through a series of prescribed burning and periodic overstory mortality treatments (stem-injected herbicides and/or girdling), short term improvements in bat roosting and forage habitat would be made. Over the longer period, overstory mortality treatments would focus on non-oak removals to create an all-oak live overstory; and only oak seedlings/saplings (or other fire tolerant species) would be present for future accession into the overstory. Unlike previous oak-fire-light studies, timber management would not be an immediate management goal.

This study would include 7 compartments (7 replicates): John B. Hollow drainage (313.9 acres, 5 treatment areas), and compartments 13 and 21 (31.3 and 30.9 acres, respectively). Approximately 3.1 miles of fire break would be established as part of this study. A study plan would be prepared and peer-reviewed prior to any treatments being implemented.

For all burning studies, the burn plan and prescribed fires would be conducted according to state regulations administered by the West Virginia Division of Forestry. A slow-moving fire (1-5 ft/min) that produces high amounts of heat (2-4 ft flame lengths) would be used. All personnel supervising and working on the fire would be trained in the use of prescribed fire and in fire suppression.

Stem injection treatments will not occur more frequently than on an annual basis and will only proceed until the desired level of overstory stocking, approximately 50% according to the upland oak stocking guide, is achieved. Glypro Plus (EPA Reg. No. 62719-322) will be used for the herbicide stem injection treatments using a 50 percent solution of concentrate and water. Stem injection will be accomplished using one incision per inch of diameter at breast height evenly spaced around the stem using 1.5 ml of solution per incision. Injections will not be made during periods of high sap flow (March, April, May) and will terminate before November. All handling and directions of the product (Glypro Plus) label will be adhered to.

Alternative C: Management Action

This alternative includes the same actions as Alternative B, and also includes activities

that are designed specifically to address the issues relating to the management of the Fernow for long term research.

To address management issues related to control of invasive exotic plants, herbicides would be applied on a total of approximately 2.5 acres to control the spread of Japanese stiltgrass in Hickam Slide, Camp Hollow, Stonelick Run, Sugarcamp Run Watersheds. Tree-of-heaven, and other invasive trees/shrubs such as autumn olive would be treated with herbicides as needed, on an individual tree basis so total acreage, though minimal, is not calcuable.

Comparison of Alternatives

This section is a comparison of the three alternatives and forms the basis for discussion of the effects in the next chapter. The issues raised in the DEIS concern impacts of research activities on threatened, endangered, and sensitive plant and animal species; and, adverse sediment impacts.

The FEF was divided into 13 subdrainages (Table 2-1) for analysis of effects on water and riparian resources. Projects are proposed in 10 of those subdrainages. The IDT developed site-specific mitigation measures to reduce adverse effects from sediment to streams and to TES species. Detailed descriptions for these and other resources are found in Chapter 3.

Table 2-1. Subdrainages and Acres of Treatment by Alternative

		Acres to be treated		
Subdrainage	**Acres**	**Alternative A**	**Alternative B**	**Alternative C**
Side Hill	83.0	0	75.5	75.5
John B Hollow	398.9	0	238.4	238.4
Bear Run	167.0	0	0	0
Hickman Slide	294.5	0	72.4	72.7
Tippy Toe Run	164.9	0	0	0
Wilson Hollow	325.8	0	0	0
Camp Hollow	487.6	0	153.7	154.1
Big Spring Run	200.0	0	15.0	15.0
Upper Elklick Run	735.8	0	162.2	162.2
Stonelick Run	620.1	0	136.4	137.4
Canoe Run	691.5	0	31.6	31.6
Sugarcamp Run	221.3	0	65.8	66.5
Fire Run	55.2	0	2.5	2.5
Total	**4445.5**	**0**	**953.5**	**955.9**

Table 2-2. Measures to Reduce Sediment Impacts

Protection Measure	Alternative A	Alternative B	Alternative C
1. Forest Plan standards and guidelines would be employed to reduce sediment impacts.	NA	X	X
2. BMPs (Best Management Practices) would be employed to reduce sediment impacts.	NA	X	X
3. Streamside management zones would be employed for identified perennial and non-perennial streams.	NA	X	X
4. Ditches and culverts would be cleaned, and gravel applied to Bear Run and Hickman Slide Roads to reduce sediment impacts.	NA	X	X
5. Silt fence would be installed below the landing in compartment 7A to control runoff.	NA	X	X
6. Landings would be graveled in compartments 19, WS5A and 61, and along Bear Run Rd to reduce sediment impacts.	NA	X	X
7. A landing for compartment WS5A along Camp Hollow would be abandoned and rehabilitated.	NA	X	X
8. A new landing would be established for compartment WS5A further away from Camp Hollow.	NA	X	X
9. Culverts would be replaced in compartments 17 and WS5A to reduce sediment impacts.	NA	X	X
10. Some sikdroads in compartment WS5A would be obliterated to control runoff.	NA	X	X
11. Ditches along Fork Mountain Rd. in compartment WS5A would be graveled or have temporary culverts installed where equipment must cross the road to reduce sediment impacts.	NA	X	X

Table 2-3. Measures to Protect Threatened, Endangered and Sensitive Species

Protection Measure	**Alternative A**	**Alternative B**	**Alternative C**
1. Dormant season logging would be used to reduce direct impacts to species	NA	X	X
2. Hickory trees would be left to protect potential habitat for endangered Indiana bats.	NA	X	X
3. Streamside management zones would be established along perennial and non-perennial streams/riparian areas providing protection to TES species that use this habitat.	NA	X	X
3. As part of a monitoring program, surveys for TES animals would be done annually and plants surveys would occur every three years.	NA	X	X
4. Monitoring of Indiana bat activity and habitat use.	NA	X	X
4. Effects to running buffalo clover would continue to be evaluated per the study design.	NA	X	X
5. Silvicultural systems employed in research would benefit certain TES species.	NA	X	X

Table 2-4. Comparison of Alternatives

Criteria	Alternative A	Alternative B	Alternative C
Total area to be treated (acres)	0	953.5	955.9
Volume (board feet removed)	0	2,729,301	2,729,301
Miles of skid road	42.6	42.6	42.6
Area (acres) in logging decks	2.8	2.8	2.8
Area (acres) treated with prescribed fire	0	204.8	204.8
Miles of new fire break	0	3.76	3.76
Area (acres) treated with tree-specific herbicides	0	134.3	134.3
Area (acres) controlled for invasive exotic plant species	0	0	2.5
Benefit/Cost Ratio	NA	2.51	2.46

Mitigation Measures

Many of the resource concerns raised during scoping, interagency discussions, and subsequent analysis did not become significant issues driving alternative development. Some of these concerns were addressed by design and implementation of the proposed activities.

Many mitigation measures are described in the section Items Common to All Alternatives. Compartment-specific mitigation measures are detailed in Tables 2-3 and 2-4.

Monitoring Activities

Because many of the proposed actions are ongoing research studies, their measurement and monitoring would continue. Forest species composition, stand development and productivity would continue to be monitored on a regular basis on the nearly 200 permanent growth plots located on the FEF.

The following monitoring activities are proposed to address issues raised in this EIS and relative to other resources on the FEF. Details of monitoring and experimental design can be found in individual study plans. This information would be put into annual monitoring reports, and published in scientific journals.

1. Channel cross-sectioning points would be established on selected stream channels to monitor changes in channel morphology. (Issue 2)

2. Substrate in some perennial stream reaches would be periodically measured to assess changes in quality. (Issue 2)

3. Surveys would be done annually for TES animals. (Issue 1)

4. Surveys for TES plants would be done every other year. (Issue 1)

5. Monitoring of Indiana Bat activity at the mouth of Big Springs Cave, and across the landscape of the FEF, would be conducted annually during swarming periods, using Anabat II detectors. (Issue 1)

6. Effects to running buffalo clover (started in 1994) would continue to be evaluated per the study plan design. (Issue 1)

7. Effects of vegetation manipulation treatments, including changes in species composition, productivity, tree quality, and regeneration, would continue to be evaluated per the study plan design.

8. Air quality monitoring would continue as currently conducted.

9. Stream water quality and soil water quality monitoring in WS3 would continue as currently conducted.

10. Stream water quality monitoring in Camp Hollow Run below WS3 would continue as currently conducted.