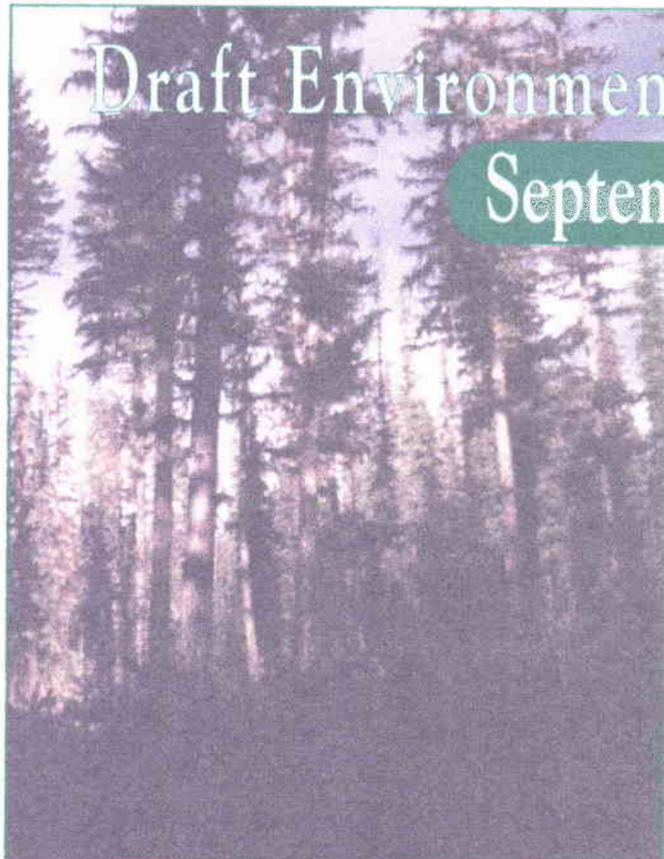
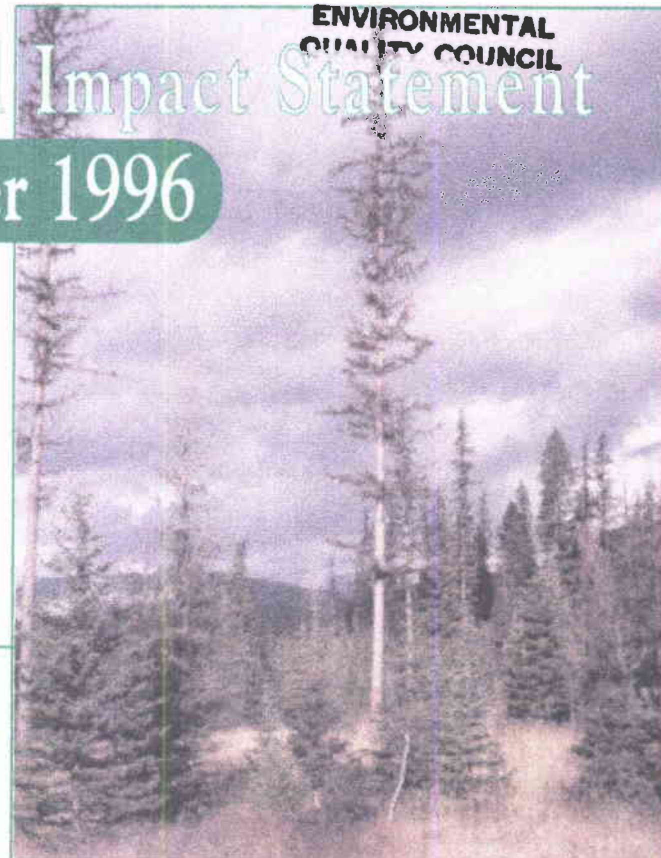
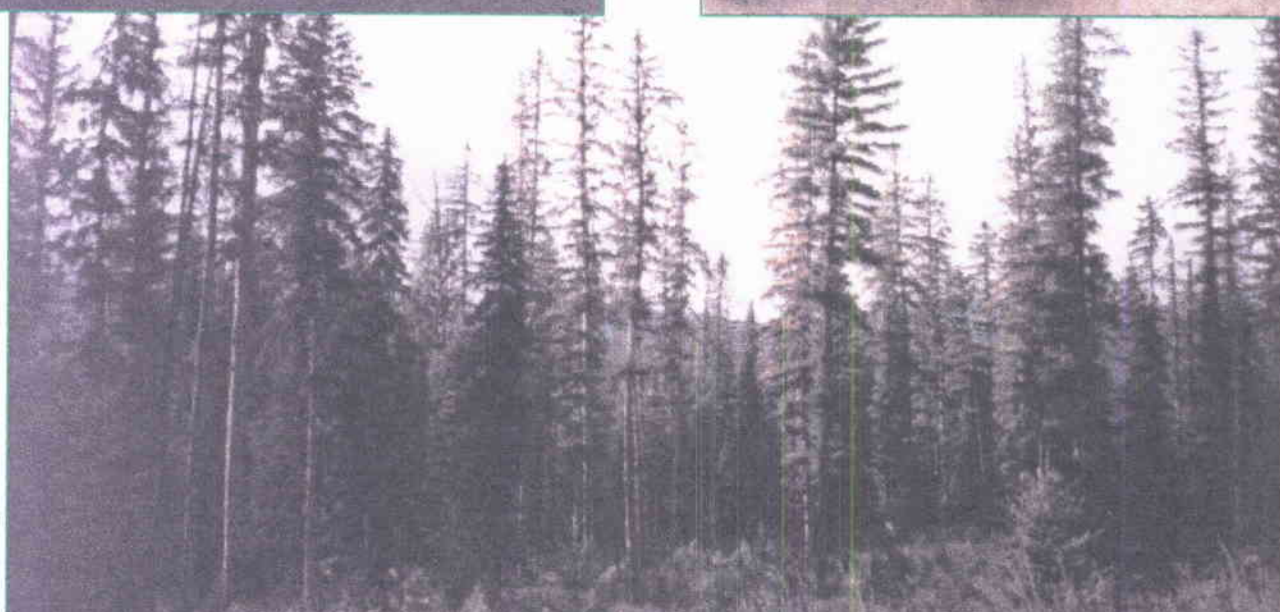
MIDDLE SOUP CREEK PROJECT

Draft Environmental Impact Statement

September 1996







Prepared by the Montana Department of Natural Resources and Conservation

DEPARTMENT OF NATURAL RESOURCES AND CONSERVATION

NORTHWEST LAND OFFICE

SWAN RIVER STATE FOREST

MIDDLE SOUP CREEK PROJECT DRAFT ENVIRONMENTAL IMPACT STATEMENT

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CHAPTER I

INTRODUCTION

INTRODUCTION

The Montana Department of Natural Resources and Conservation (DNRC), Swan River State Forest (SRSF), proposes the Middle Soup Creek Project. The purpose of the project is to generate revenue for the Montana School Trust from project area lands. The project area is located approximately seven miles southeast of Swan Lake, Montana, in Sections 21 and 28, and in portions of Sections 9, 16, 22, 27 and 33, T24N-R17W (Figure 1.1). The 2,591 acres within the project area are owned by the State of Montana and held in trust by DNRC. Timber sale and conservation lease opportunities resulting from the project would be advertised in February, 1997. Timber sale activities would run for approximately two consecutive years. A conservation lease would be valid for twenty years.

I. PURPOSE

A. School Trust Mandate

The lands involved in this project are held by the State of Montana in trust for the support of public schools (Enabling Act 1889). The Board of Land Commissioners and DNRC are required by law to administer these trust lands to produce the largest measure of reasonable and legitimate return over the long run for public schools (Montana Code Annotated 1995b). The Board and DNRC have a broad discretion as to the best way to satisfy this legal mandate, subject to applicable state and federal law.

For the lands involved in this project, DNRC believes that management for timber is the best way to satisfy this legal mandate for the foreseeable future.

FIGURE 1.1 MIDDLE SOUP VICINITY AREA

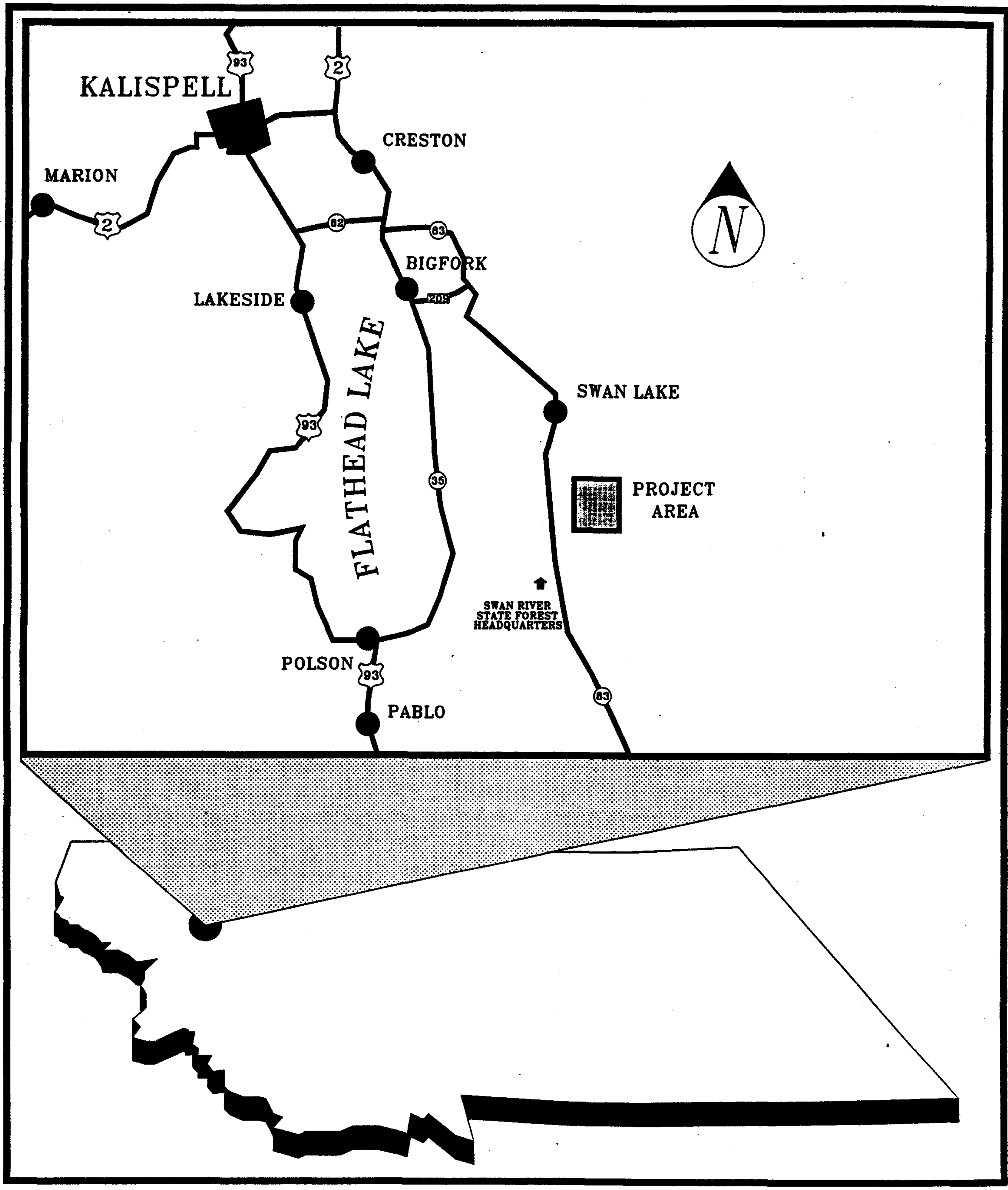


Figure 1.1

B. Proposals

In keeping with the "School Trust Mandate", the objective of the Middle Soup Creek Project is to generate the largest, reasonable monetary return to the school trust in both the short term and the long term by (a) selling approximately six million board feet of timber on the project area lands or (b) selling a twenty-year conservation lease for the lands.

1. Timber sale

The following considerations influenced the selection of the project area, the size of the project area, and the amount of timber to be sold:

1. Efficiently generating revenue as required by the Montana Constitution (Enabling Act 1889)

2. Harvesting approximately 6 MMBF of timber while maintaining the natural resource thresholds identified and recommended by resource specialists that were consulted (Resource specialists are listed in "Preparers and Contributors.")

3. Treating forest stands classified as "high risk," "low risk," and "overstory removal" in the SRSF Stand Level Inventory (Montana Dept. of State Lands 1991-1994)

4. Containing the project area within one grizzly bear management subunit (US Fish and Wildlife Service 1993)

5. Limiting the number of watersheds affected to the Soup Creek and Cilly Creek drainages

2. Conservation lease

As a separate option from harvesting timber, DNRC proposes to generate revenue by selling a conservation lease for the project area lands. The lease would preserve and protect the project area for twenty years. Appendix C contains a copy of the conservation lease.

A bid for a conservation lease must compare favorably to the highest timber sale bid. If one of the action alternatives is selected, bids for a timber sale representing the selected action alternative and a conservation lease would be accepted. Conservation lease bids would be compared to the highest timber sale bid using the method that is detailed in Chapter IV, "Economic Analysis." Whichever option would generate the most revenue for the school trust over the long term would be implemented.

The environmental effects of a conservation lease would be the same as the effects of the no-action alternative for the 20 years the lease would be in effect. No timber harvests would be proposed over the term of the lease.

C. Decision Making

This EIS will provide the basis for deciding what (if any) actions will be taken on the project area lands. The "decision maker" will select one of the four alternatives outlined in this EIS. The decision maker will consider which alternative would generate the largest, reasonable, short- and long-term monetary return to the school trust. He will also consider how individual effects of the project would collectively impact the long-term health of the ecosystem, long-term timber productivity, and future economic opportunities.

If an action alternative is selected, the Board of Land Commissioners must approve the selected alternative before bids can be accepted.

II. DEVELOPING RESOURCE CONCERNS

A. Scoping

Comments from organizations, federal and state agencies, DNRC specialists, and the public defined the scope of this EIS (Table 1.1). DNRC solicited participation in the Middle Soup Creek Project by advertising in newspapers and distributing a project proposal to interested individuals, landowners, organizations, industries, and agencies on September 19, 1994. DNRC accepted comments on the proposal for 30 days. Field reviews were held with representatives of Friends of the Wild Swan to clarify their concerns. A draft EIS will be made available for public review in September, 1996 and a public hearing will be held prior to the completion of a final EIS in October, 1996.

The project proposal mailing list is located in Appendix A. Public scoping comments are located in Project Files 303 to 307.

B. Interdisciplinary Team

An interdisciplinary (ID) team consisting of eight resource specialists considered all scoping comments. The ID team identified resource concerns that the project may impact. The resource concerns were identified and categorized based on the comments, the expertise of the ID team members, and their knowledge of the project area. The concerns were divided into three categories: major resource concerns, other resource concerns, and dismissed concerns. The concerns in the categories received varying degrees of analysis.

The ID team members are listed in Appendix B.

Table 1.1 ***Public Participation***

Date	Scoping
September 1994	The project proposal was mailed to interested individuals, owners of adjacent land, special interest groups, private industry, and federal and state agencies (Appendix A). Paid advertisements were sent to local papers (Appendix A). A 30-day comment period began.
October 1994	Comments on the proposal were received from two landowners, Friends of the Wild Swan, the MFWP, DNRC land managers, and the ID team.
Date	**Ongoing Public Involvement**
March 1995	DNRC project leaders held a meeting with concerned citizens.
May 1995	DNRC project leaders conducted a field reconnaissance with concerned citizens.
July 1995	DNRC project leaders conducted a second field reconnaissance with concerned citizens.
Date	**Formal Public Review**
September 1996	Draft EIS issued for public review and comment. A public hearing will be held. The comment period will be 45 days long.
November 1996	Final EIS available for public review.
November 1996	The finding issued.

III. MAJOR RESOURCE CONCERNS

The major resource concerns: ecosystem sustainability, old-growth preservation, and timber productivity, required in-depth analysis and ultimately led to the development of action alternatives (introduced in Chapter II). Each major resource concern has been resolved through at least one action alternative. The major resource concerns are briefly described below and explored in greater depth in chapters II, III, and IV.

A. Ecosystem Sustainability

Timber harvesting may reduce the total area of forest, alter the overall ecological characteristics of forested stands in the project area, and reduce the structural and compositional diversities of stands required to maintain natural ecosystem functions.

Timber harvesting may further fragment existing stands in the project area, increasing edge effects and raising forest fragmentation beyond acceptable levels for the maintenance of natural biological diversity.

B. Old-Growth Preservation

Timber harvesting may significantly alter the character of old-growth stands within the project area and impact the connectivity of those stands with old-growth stands adjacent to the project area.

Past timber harvesting activities in the Soup Creek and Cilly Creek watersheds may have degraded old growth and its unique qualities to the point that additional timber harvesting in old-growth stands may be unacceptable.

Timber harvesting may ruin the opportunity to use existing old-growth stands as "outdoor classrooms" where the ecological uniqueness of old-growth forests can be studied.

C. Timber Productivity

Mitigation resolving nontimber resource concerns may over-compromise timber productivity and the potential of timber production to support school trusts in both the short term and the long term.

IV. OTHER RESOURCE CONCERNS

Other resource concerns required varying degrees of (and often in-depth) analysis. They are resolved by the project design or by mitigation measures. The following other resource concerns are described here: grizzly bear, elk, white-tailed deer, gray wolf, sensitive animal species, cavity-dependent wildlife, water quality, fisheries, air quality, soil, noxious weeds, and aesthetics.

A. Grizzly Bear

Previous land management activities may have negatively impacted the grizzly bear population in and around the project area. Past road building has facilitated use of the area by people which can increase bear mortality and displace bears from biologically suitable habitats. Exclusion of bears from the project area could further isolate grizzly bears in the Mission Mountains, increasing their likelihood of extirpation.

B. Elk and White-Tailed Deer
Timber harvesting may affect elk and white-tailed deer populations both positively and negatively. Tree removal may reduce availability of hiding and thermal cover but increase forage availability. Road construction and improvement may improve hunter access, reducing security. Negative impacts on elk and white-tailed deer populations may affect the local economy through reductions in wildlife-related recreation.

C. Gray Wolf
Wolves are not known to presently inhabit the Swan Valley. Wolves are, however, increasing in number and distribution in western Montana (US Fish and Wildlife Service 1995b). The similarity of the Swan Valley to areas in northwest Montana recently colonized by wolves suggests that it could support wolves. Increased human activity may increase the chances of human-caused wolf mortality.

D. Sensitive Animal Species
Timber harvesting activities may adversely impact wildlife species that are closely associated with old growth and/or that are particularly sensitive or vulnerable to human disturbance.

E. Cavity-Dependent Animal Species
Timber harvesting activities may impact species that use snags and decayed trees for nesting, roosting, feeding, and shelter. In the 1970's and 1980's salvage harvesting was conducted in the project area. The salvage harvesting may have compromised habitat for cavity-dependent species, and this project may further reduce habitat quality.

F. Water Quality
Timber harvesting activities may impact water quality. Specifically, water yields and sedimentation may increase. The quality of water in the immediate area and downstream may be affected. Where water quality was impacted, fisheries would most likely be impacted.

G. Fisheries
Timber harvesting activities may impact westslope cutthroat trout and bull trout populations if water quality is affected.

H. Air Quality
Air quality may be degraded when logging slash is burned after timber harvesting.

I. Soil
Timber harvesting activities may result in soil rutting, compaction, and displacement. Site productivity may be reduced.

J. Noxious Weeds
Timber harvesting activities and increased motorized traffic resulting from the project may promote the invasion and establishment of noxious weeds.

K. Aesthetics
The project area may provide aesthetic enjoyment to the recreating public. Timber harvesting activities may alter the color, texture, shape, contrast, and feeling of the existing landscape. The impacts of the project on aesthetics may be amplified if the timber harvesting activities were visible from the well-traveled Soup Creek and Cilly Creek roads.

V. CONCERNS NOT FURTHER ANALYZED
The following concerns were given careful consideration before the ID team decided not to pursue further analysis: Scenic Highway 83, Soup Creek Campground, cultural resources, bald eagle, peregrine falcon, special status plants, and some sensitive animal species. These concerns are either unlikely to be impacted by the Middle Soup Creek Project, or current laws and regulations already address them.

A. Scenic Highway 83

1. Concern
Timber harvesting activities may degrade the scenic quality of Highway 83 which is important to the residents of Swan Valley and others who drive on Highway 83.

2. Reason not to pursue further analysis
The visual effects of timber harvesting activities would not be seen from Highway 83. The project area is located 1.5 air miles east of Highway 83, and it has a low topographic setting on the Swan Valley floor (Figure 1.1).

B. Soup Creek Campground

1. Concern
Timber harvesting may impact the recreational availability of Soup Creek Campground which is located within the project area .

2. Reason not to pursue further analysis
Project activities would not impact the Soup Creek Campground, but some short-term reduction in campground use may occur. Project activities are not planned within view of the campground and no restrictions or closures will be implemented because of the project; however, noise and traffic associated with project activities may temporarily

discourage campground use. Log landings may be temporarily visible from the campground.

C. Cultural Resources

1. Concern

Timber harvesting activities may degrade a trail passing through the project area from the Swan River to the South Fork of the Flathead River. The trail was identified from a 1915 General Land Office map by the DNRC Archeologist. The trail may have been used by Native Americans and thus may be culturally important.

2. Reason not to pursue further analysis

The trail could not be located on the ground. The Flathead Culture Committee of the Salish and Kootenai Tribes are unaware of any culturally important concerns in the project area. If additional field reconnaissance identified the trail or other cultural resources, mitigation measures would be implemented (Appendix D).

D. Threatened and Endangered Animal Species

1. Bald eagle

a. concern

Timber harvesting activities may affect habitat and behavior of bald eagles that nest in or near the project area. The bald eagle is classified as threatened, and is protected under the Endangered Species Act.

b. reason not to pursue further analysis

Strategies to protect the bald eagle are outlined in the Pacific States Bald Eagle Recovery Plan (US Fish and Wildlife Service 1986) and the Montana Bald Eagle Management Plan (Montana Bald Eagle Working Group 1994). Management direction involves identifying and protecting nesting, feeding, perching, roosting, and wintering/migration areas (US Fish and Wildlife Service 1986, Montana Bald Eagle Working Group 1994).

There is an eagle nest within six miles of the project area boundary on Swan Lake. The project area is outside the recommended home-range management area of a 2.5-mile radius around the nest. The closest documented eagle roost site was over two miles from of the project area boundary (McClelland 1995). The project area is also outside potential unoccupied nesting habitat along the Swan River. Bald eagles are not known to winter in the project area, and timber harvesting will not affect migration behavior.

Management objectives for foraging habitat involve the regulation of poisons and chemicals, maintenance of water quality and populations of prey species, and elimination of electrocution hazards in foraging habitat (US Fish and Wildlife Service 1986, Montana Bald Eagle Working Group 1994). No poisons or electrocution hazards would be introduced into the area as a result of the proposed action (and none exist there now). The herbicides picloram and 2,4-D would be used to control noxious weeds along roads. Neither herbicide bioaccumulates and neither should pose a threat to bald eagles if applied at recommended doses. Potential bald eagle foraging habitat in the project area includes small ponds and streams that support fish populations, and marshes and meadows that support rodents. Project activities are not being considered in small ponds, streams, meadows, or marshes, and the bald eagle prey base would not be impacted. For these reasons, bald eagles should not be affected and this concern will be dropped from further analysis.

2. American peregrine falcon

a. concern

Timber harvesting activities may affect habitat and behavior of peregrine falcons nesting in or near the project area. The peregrine falcon is classified as endangered in Montana, and is protected under the Endangered Species Act.

b. reason not to pursue further analysis

Strategies to protect and recover populations are outlined in the American Peregrine Falcon Recovery Plan (US Fish and Wildlife Service 1984). One pair of peregrine falcons has been observed in the Swan Valley during the nesting season in recent years, in 1993. The pair is thought to nest approximately 16 miles northwest of the project area, although nesting has not been confirmed. No other peregrine falcons are suspected to nest in the Swan Valley (Warren 1995).

Peregrine falcons may travel up to 18 miles from the nest in search of prey. Peregrine falcons feed almost exclusively on birds, preferably ducks, shorebirds and songbirds. Hunting habitats include river bottoms, lakes, meadows, marshes, agricultural croplands, and coniferous forests. Some marshy areas exist in the project area. These are marginal feeding sites, however, because they are isolated from suitable nesting sites and surrounded by heavy timber. No timber harvesting would take place in these marshy areas and potential hunting habitats would not be affected.

Timber harvesting is not likely to affect peregrine falcon nesting sites. Peregrine falcons typically nest on cliff ledges, rock outcrops, or talus slopes. Preferred nest sites overlook meadows and riparian habitat. Rocky outcrops or talus slopes exist in three locations within a few miles of the project area. These areas and approximate distances from the project area boundaries are as follows: Goat Creek Canyon, 2 miles south; Soup Creek Canyon, 1 mile east; and South Lost Creek, 1 mile north. The rocky outcrops or talus slopes in all these areas are surrounded by heavy timber, and are snow covered late into the peregrine falcon breeding season, making them less than desirable nesting sites. In addition, because peregrine falcons exhibit nest site fidelity and do not readily colonize new areas, these areas are not likely to be colonized by peregrine falcons.

Peregrines falcons have been sighted in the Swan Valley during spring and fall migration. Timber harvesting would not impede migratory movements and mortality risk would not increase due to proposed management actions. Because project activities would not have an effect on nesting or foraging habitat, and would not disrupt migratory movements, this concern would be dismissed from further environmental analysis.

E. Sensitive Animal Species not Further Analyzed

1. Concern

Timber harvesting activities may impact the following sensitive animal species that occur near SRSF on Flathead National Forest (FNF): common loon, boreal owl, flammulated owl, harlequin duck, and bog lemming. These species are dismissed for one or more of the following reasons: (a) they are not old-growth associated, (b) they are not particularly sensitive to human disturbance, © they are not cavity-dependent, (d) the project area does not meet their habitat requirements, or (e) clearly, timber harvesting activities would not impact them. Specific reasons for dismissal are given below.

2. Reason not to pursue further analysis

a. common loon

Loon nests are placed immediately adjacent to water. Nesting territory is highly variable, but is about 40 acres. No loon nests have been found in the project area (Montana Natural Heritage Program), and the closest loon nests are along the Swan River (Skarr 1989). Management for loon habitat is not required in areas that have not documented loon nesting (Skarr 1989), and this concern will be dismissed from further analysis.

b. boreal owl

Boreal owls inhabit mature to old-growth spruce-fir forests at elevations of 4200 to 8000 feet on the FNF. Elevations in the project area range from about 3360 to 3800 feet. This is lower than the elevation range preferred for breeding, although they may feed in this elevation range. Major prey items are mice, voles and shrews, preferentially in spruce-fir forest of pole size or greater trees. Boreal owls often feed at forest edges and in previously harvested areas. They are apparently not sensitive to human disturbance when feeding (Reichel 1995). For these reasons, boreal owls should not be affected by the project.

c. flammulated owl
Flammulated owls typically nest in mature to old-growth ponderosa pine or ponderosa pine/Douglas-fir forests. Nest stands have moderate canopy closure (30-50%) and an open understory, allowing the birds to maneuver and catch insects. The flammulated owl should not be affected by the action because no stands are being considered for harvest that meet the above description.

d. harlequin duck
Harlequin ducks use swift, clean, clear streams with cobble to boulder substrate on second to fifth order streams. Extensive surveys for harlequin ducks have been conducted in the Swan Valley, and none have been found. The project area is far from any known populations, and the probability of recolonization of this area by harlequin ducks is very small (Reich 1995). For these reasons, the project will not affect harlequin ducks.

F. Special Status Plants

1. Concern
Timber harvesting activities may impact two sensitive plant species, green-keeled cottonsedge (*Eriophorum viridicarinatum*) and small yellow lady's-slipper (*Cypripedium calceolus* var. *parviflorum*), that occur within the project area (Montana Natural Heritage Program). Both plants occur on a very wet, marshy site in the SW ¼ of Section 21, T24N, R17W.

Water howellia (*Howellia aquatillis*), a threatened aquatic plant, occurs in the Swan Valley (its closest occurrence to the project area is just to the north of the confluence of the Swan River and Cilly Creek), although it has not been found in SRSF (Montana Natural Heritage Program).

2. Reason not to pursue further analysis
There is little potential that timber harvesting would affect green-keeled cottonsedge, small yellow lady's-slipper, or water howellia. Both green-keeled cottonsedge and small yellow lady's-slipper occur on a very wet, marshy site. No water howellia has been found within the project area, but water howellia also occurs on wet sites. Project activities would not take place on wetland sites (Shelly et. al. 1995, Project File 601).

Protection for wetland sites would be provided through Best Management Practices 1991 and the Streamside Management Zone Law 1991 (Logan 1991, Montana Dept. of State Lands 1991).

VI. OTHER ENVIRONMENTAL REVIEWS RELATING TO THE PROJECT

A. Middle Soup Environmental Assessment

1. History

The Middle Soup Environmental Assessment (EA) proposed to sell approximately three million board feet of timber. It evaluated the consequences of three action alternatives and one no-action alternative, and it was completed in February, 1993. As a result of decisions that were based on the EA, the Middle Soup Creek Timber Sale was awarded to Champion International Corporation in November, 1993. By the end of that year, Champion International Corporation had constructed five temporary spur roads (totaling 0.5 mile), completed various other road maintenance projects, and removed seventy-four thousand board feet of right-of-way timber. In January, 1994, the Friends of the Wild Swan applied to the Montana Eleventh Judicial District Court for a preliminary injunction against the Department of State Lands and Champion International Corporation. In February, 1994, the court granted Friends of the Wild Swan the preliminary injunction. DNRC then withdrew the EA and the timber sale.

2. Relevance to this EIS

The scope of this Environmental Impact Statement (EIS) is influenced, and the content supplemented, by The Middle Soup EA. Roads that were constructed under the Middle Soup Timber Sale are included in the road density figures in this EIS.

B. South Fork Lost Creek EIS

The SRSF is preparing an EIS for the South Fork Lost Creek Timber Sale. The South Fork Lost Creek Project Area is located approximately four air-miles northeast of the Middle Soup Creek Project Area. The project areas do not overlap.

The Middle Soup Creek Project EIS and the South Fork Lost Creek EIS use the same analysis areas for grizzly bear and air quality concerns. For both projects the cumulative effects on grizzly bears will adhere to the guidelines set forth in the Swan Valley Grizzly Bear Conservation Agreement and will tier to the corresponding Environmental Assessment by the US Fish and Wildlife Service, the Biological Opinion by the US Fish and Wildlife Service, and the Environmental Assessment

Checklist by DNRC, all completed in 1995. Air quality cumulative effects will not exceed the limits defined by the Montana Cooperative Smoke Management Plan (State of Montana Cooperative Smoke Management Plan 1988).

The analysis areas for elk, white-tailed deer, and gray wolves overlap slightly. Five percent, or 290 acres, of the Middle Soup Creek Project analysis area for elk, white-tailed deer, and gray wolves overlaps with the South Fork Lost Creek Timber Sale's analysis area for these species. Since no treatments would be applied by either project within the area of overlap, and the area of overlap represents only five percent of the Middle Soup Creek Project analysis area, cumulative effects would be minimal. The South Fork Lost Creek EIS will contain an assessment of potential cumulative effects, including the effects of the Middle Soup Creek Project.

C. The Swan Valley Grizzly Bear Conservation Agreement

Beginning in December 1994, DNRC participated in the development of the Swan Valley Grizzly Bear Conservation Agreement (SCA) with the U.S. Fish and Wildlife Service, Flathead National Forest, and Plum Creek Company, L.P. The SCA seeks to cooperatively manage grizzly bear habitat in the Swan Valley where intermingled ownership patterns and differing land management objectives complicate habitat management for a species as wide-ranging as the grizzly bear. The U.S. Fish and Wildlife Service evaluated the SCA in an environmental assessment and found that implementing the management guidelines in the agreement would not negatively impact grizzly bears (US Fish and Wildlife Service 1995c).

The Middle Soup Creek Project Area is within the conservation area delineated in the SCA. Since the grizzly bear analyses for this project were completed before the SCA was evaluated, they follow the previously used methods (which are still used for the Northern Continental Divide Ecosystem Grizzly Bear Recovery Area outside of the conservation area). Future analyses in the SCA Conservation Area will follow the SCA. An "SCA checklist" was compiled to evaluate compliance of all alternatives with the SCA and is included in the project file.

D. State Forest Land Management Plan

DNRC completed a final EIS for the State Forest Land Management Plan (SFLMP) on May 15, 1996 (Montana Dept. of Natural Resources and Conservation 1996). A Record of Decision was issued May 30, 1996 identifying OMEGA as the selected alternative (Clinch 1996). The selected alternative was approved by the Board of Land Commissioners, in June, 1996.

SRSF harvest goals are established by the Northwest Land Office under guidance of the annual sustained yield statute (Montana Code Annotated 1995c). Forest Management activities to meet harvest goals are guided by the SFLMP.

CHAPTER II

ALTERNATIVES

INTRODUCTION

Chapter II describes the development of three "action alternatives," and a "no-action alternative." The action alternatives represent three different strategies for generating revenue to meet the project objectives. In addition to describing the alternatives, this chapter describes silvicultural treatments, the alternative development process, and mitigation measures that are common to all the action alternatives.

I. SILVICULTURAL TREATMENTS

The three action alternatives employ combinations of four different silvicultural treatments. The silvicultural treatments proposed for the Middle Soup Creek Project have been designed to simulate many effects of various fire intensities that historically occurred. They are intended to promote natural levels of structural and compositional diversity.

The following treatments are described below: light-reserve,.regeneration harvesting; moderate-reserve, regeneration harvesting; heavy-reserve, regeneration harvesting; and structural enhancement. How each alternative would employ these various treatment is described in section III, "Alternatives."

A. Light-Reserve, Regeneration Harvesting

1. Harvesting

Light-reserve, regeneration harvesting would simulate many of the effects of a high-intensity, stand-replacing fire. Such a fire would greatly alter the structure and composition of overstory and understory vegetation. Light-reserve treatment would remove most of the overstory and understory vegetation within cutting units. Hiding and thermal cover would not be retained; however, the following important stand components would be reserved when available:

1. Approximately two large trees per acre having an average diameter around 22 inches. Preferred reserve trees would include western larch (*Larix occidentalis*), Douglas-fir (*Pseudotsuga menziesii*) and ponderosa pine (*Pinus ponderosa*)--tree species that have a high resistance to fire and wind. Reserve trees would provide for structural diversity and future snag recruitment. Light-reserve treatment would only be applied to stands that do not contain sufficient numbers of quality seed trees, but reserved trees would represent the healthiest trees available. They would have intact crowns, but they may not always meet seed tree quality. Reserved trees should not be likely to spread disease.

2. Small, scattered clumps of healthy, residual understory.

3. Approximately two live trees per acre, having broken boles, that would not be likely to spread disease.

4. Dead, standing trees that do not qualify as hazards under OSHA regulations (Logging Operations [Final Rules] 1995).

5. Fifteen to twenty tons per acre of large, down, woody material.

Retention of these stand components would depend on their presence, health, and vigor. Stand components would be reserved in a manner consistent with vegetation patterns and land contours; that is, they would be reserved in various, naturally-occurring shapes and sizes. The residual stand would average 10 square feet in basal area per acre and have 11 percent crown cover.

2. Residue disposal and site preparation

Reducing the fire hazard created by logging residue would be accomplished by excavator-piling and hand-burning residue.

To prepare the site for regeneration, mineral soil would be exposed on thirty to forty percent of the site. This scarification would be accomplished using an excavator-piler. The soil would be scarified over the entire site in randomly-spaced patches varying in size.

3. Regeneration

The prepared site would favor the establishment of shade-intolerant species. Favoring the establishment of shade-intolerant species would contribute to structural and compositional diversity by promoting the long-term presence of many species having varying degrees of shade tolerance.

Regeneration would establish primarily from adjacent stands. Natural regeneration would be supplemented by interplanting western white pine (*Pinus monticola*) that is resistant to white pine blister rust, a major cause of western white pine mortality on the SRSF. Interplanting rust-resistant western white pine would promote its continued presence in the project area.

B. Moderate-Reserve, Regeneration Harvesting

1. Harvesting

Moderate-reserve, regeneration harvesting would simulate the effects of a moderate-intensity, stand-replacing fire. Such a fire would greatly alter the structure and composition of both overstory and understory vegetation. Moderate-reserve treatment would remove most overstory and understory vegetation within cutting units. Hiding and thermal cover would not be retained; however, the following important stand components would be reserved when available:

1. Approximately six large (at least 20 inches dbh), healthy, seed trees per acre having straight boles and good crown development. Preferred reserve tree species would include western larch, Douglas-fir, and ponderosa pine. Depending on availability, reserved trees would be scattered at random or reserved in groups.

2. Small, scattered clumps of healthy understory.

3. Approximately two live trees per acre having broken boles that would not be likely to spread disease.

4. Dead, standing trees that do not qualify as hazards under OSHA regulations (Logging Operations [Final Rules] 1995).

5. Fifteen to twenty tons per acre of large, down, woody material.

As with light-reserve treatment, the retention of these stand components would depend on their presence, health, and vigor. Stand components would be reserved in various, naturally-occurring shapes and sizes. The residual stand receiving moderate-reserve treatment would average 21 square feet of basal area and have approximately 18 percent crown cover.

2. Residue disposal and site preparation
As with light-reserve treatment, residue disposal would be accomplished by excavator-piling and hand-burning residue.

To prepare the site for regeneration, mineral soil would be exposed on thirty to forty percent of the site. This scarification would be accomplished using the excavator-piler. The soil would be scarified over the entire site in randomly-spaced patches varying in size.

3. Regeneration
The prepared site would favor the establishment of shade-intolerant species. Favoring the establishment of shade-intolerant species would promote long-term structural and compositional diversity. Regeneration would establish by seed from reserve trees and adjacent stands. As with light-reserve treatment, natural regeneration would be supplemented by interplanting rust-resistant, western white pine.

C. Heavy-Reserve, Regeneration Harvesting

1. Harvesting
Heavy-reserve, regeneration harvesting would simulate the effects of a ground fire having varying intensity. Such a fire would alter stand density and species composition of overstory and understory vegetation. Heavy-reserve treatment would remove 20 to 70 percent of the overstory trees in a cutting unit, depending on the existing stand density. Currently the basal area of mature stands in the project area ranges from 100 to 240 square feet per acre; heavy-reserve treatment would reduce basal area to approximately 80 square feet. Trees would be removed singly, in groups, or in stringers not larger than one-half acre. Shade-intolerant species would be favored; however, some of all existing species would be reserved. Live trees with broken boles and dead standing trees that do not qualify as hazards under OSHA regulations (Logging Operations [Final Rules] 1995),

would be reserved. Fifteen to twenty tons of large, down, woody material would also be reserved. The basal area reduction would maintain an average crown cover of approximately 70 percent. Hiding and thermal cover would be retained.

2. Residue disposal and site preparation

As with light- and moderate-reserve treatments, residue disposal would be accomplished by excavator-piling and hand-burning logging residue.

To prepare the site for regeneration, mineral soil would be exposed on twenty to thirty percent of the site. This scarification would be accomplished using the excavator-piler. Where patches, groups, or stringers of trees were removed, the soil would be scarified in randomly-spaced patches varying in size.

3. Regeneration

The prepared site would promote establishment of both shade-tolerant and shade-intolerant species thus promoting long-term structural and compositional diversity. Regeneration would establish by seed from the residual overstory. Natural regeneration would be supplemented by interplanting rust-resistant western white pine.

D. Structural Enhancement

1. Thinning

Structural enhancement would simulate the effect of multiple, scattered, low-intensity ground fires. Such fires would alter stand density and species composition primarily in the lower canopy layer. Understory vegetation would be lightly disturbed. Structural enhancement would reduce the basal area of stands by approximately ten percent. One-half-acre patches would be selectively thinned intermittently throughout the stand. Patches would be selected where shade-tolerant species are encroaching on shade-intolerant species. To further simulate the effects of low-intensity ground fire, thinning within patches would favor the removal of shade-tolerant trees having thin bark and crowns low to the ground. Some shade-intolerant species would also be removed to improve spacing and extend the presence of other healthy, shade-intolerant dominant and codominant trees. Live trees with broken boles, large down woody material, and dead, standing trees that do not qualify as hazards under OSHA regulations would be reserved.

2. Residue disposal and site preparation

Logging residue would be hand-lopped and scattered. Because structural enhancement is not a regeneration treatment, site preparation would not be required.

3. Regeneration

Regeneration would not be promoted by this treatment. Structural enhancement would reduce competition from encroaching shade-tolerant species and extend the presence of large, shade-intolerant trees thereby maintaining species diversity.

II. DEVELOPMENT OF ACTION ALTERNATIVES

A. Purpose of Action Alternatives

Action alternatives are developed to meet project objectives in alternative ways that would resolve each resource concern within one alternative. Because resolving some concerns creates conflicts with resolving others, mitigation measures are developed. Mitigation measures are placed in groups, and the groups provide a framework for developing action alternatives.

Alternatives must be realistic and technologically available, and they must logically relate to the project proposal. A "no-action" alternative provides the baseline for comparing the environmental consequences of other alternatives. The no-action alternative is considered a viable alternative (Montana Codes Annotated 1995a).

B. Developing Action Alternatives for the Middle Soup Creek Project

The action alternatives for the Middle Soup Creek Project were developed to resolve the three major resource concerns: ecosystem sustainability, old-growth preservation, and timber productivity. The other resource concerns described in Chapter I are resolved through mitigation measures.

III. ALTERNATIVES

This section describes the no-action alternative, and proposed harvesting, logging methods, and mitigation measures that are specific to each action alternative. Mitigation measures that are common to all of the action alternatives are outlined in Appendix D.

None of the alternatives would require any new road construction because 5 spur roads totaling 0.53 mile were already constructed under the Middle Soup Timber Sale before it was withdrawn.

A. Alternative A
Alternative A is the no-action alternative. If Alternative A were selected, no timber harvesting would occur as a result of this project. Land management activities could be proposed and undertaken in the future following the appropriate level of MEPA review. In the event a conservation lease is issued, timber harvests would not be proposed over the term of the lease (20 years). Figure 2.1 shows the project area as it would continue to exist under Alternative A.

B. Alternative B: Ecosystem Sustainability

1. Summary
Alternative B attempts to resolve the major resource concern of ecosystem sustainability. Alternative B would promote the integrity of ecosystem functions within the project area by employing a combination of three strategies: conserving mature forest, reducing forest fragmentation, and maintaining structural complexity and diversity in the project area.

a. conserving mature forest
Mature forest would be conserved to perpetuate an environment upon which many species depend. Mature forest corridors would be retained to allow sensitive, mature forest-dependent species to move between core areas. Large, contiguous, and relatively intact polygons of forest characterized by mature forest attributes would be maintained.

Timber would be harvested using the structural enhancement silvicultural method within mature forest core and corridors. This method is designed to minimize alteration to stand character and function within corridors, old growth, or mature forest core.

(1) mature forest interior core areas
Core areas are defined herein as contiguous stands of mature forest that maintain a core of 50 hectares (123.5 acres) or greater after being buffered from adjacent immature stands by a 100 meter strip of mature forest.

MIDDLE SOUP EIS

FIGURE 2.1 ALTERNATIVE A PROJECT AREA

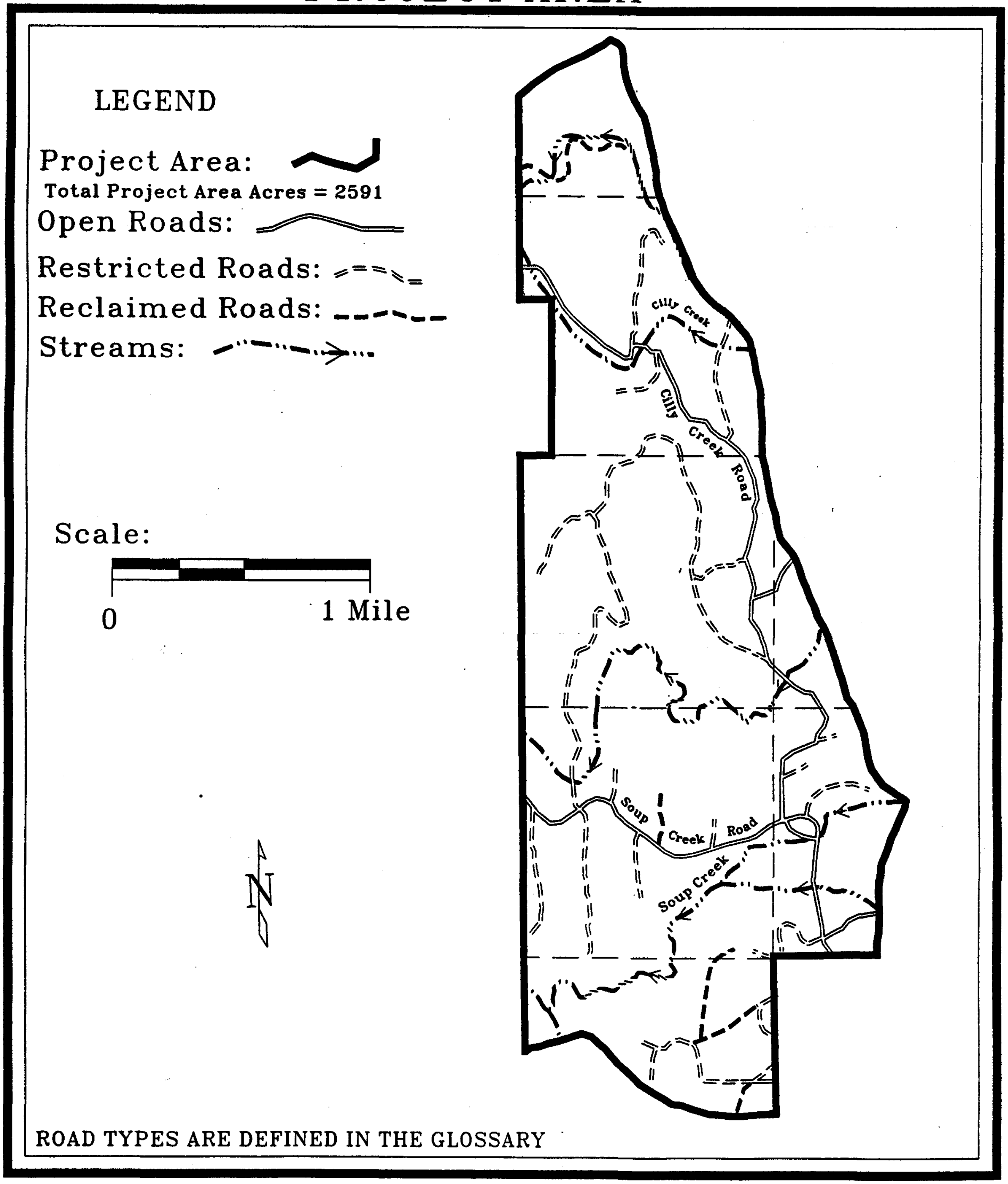


Figure 2.1

(2) mature forest corridors
Mature forest corridors are defined herein as contiguous forested areas that are at least 100 meters (327 feet) in width, have at least 40 percent canopy closure, and connect isolated stands of mature forest.

b. reducing habitat fragmentation
Harvesting methods would promote multistoried, mixed-age transitions to soften sharp edges on existing forest patches. Corridors would be retained, and isolated patches of timber would be harvested to reduce fragmentation and produce a forest that would more closely mimic a forest subjected to natural processes.

c. maintaining structural complexity and diversity within stands
Since the 1940's, active fire suppression has led to increased dominance of shade-tolerant species and increased stand densities throughout the Swan Valley. Some dense stands would be thinned to promote more historical, savannah-like conditions thus improving the structural integrity of stands. Encroaching shade-tolerant species would be harvested to promote long-term, compositional diversity in stands.

2. Methods
Under Alternative B, approximately 5.2 MMBF of timber would be harvested on 1006.2 acres. Moderate-reserve, regeneration harvesting would be applied to 44.3 of those 1006.2 acres (cutting units B1 and B2). Heavy-reserve, regeneration harvesting would be applied to cutting units B3 though B7 totaling 129.2 acres. Structural enhancement would be applied to B8 through B18 totaling 832.7 acres. Figure 2.2 shows the location of the cutting units and the type of treatment each cutting unit would receive.

Conventional tractor-logging methods would be used. The tractor size would not exceed the equivalent of a JD 650C/D6D track-type tractor or a JD 540/518C rubber-tired skidder (machines that do not exceed nine feet in width and twenty feet in length). These limitations provide maneuverability that protects remaining trees and limits soil compaction.

MIDDLE SOUP EIS

FIGURE 2.2 ALTERNATIVE B CUTTING UNITS:

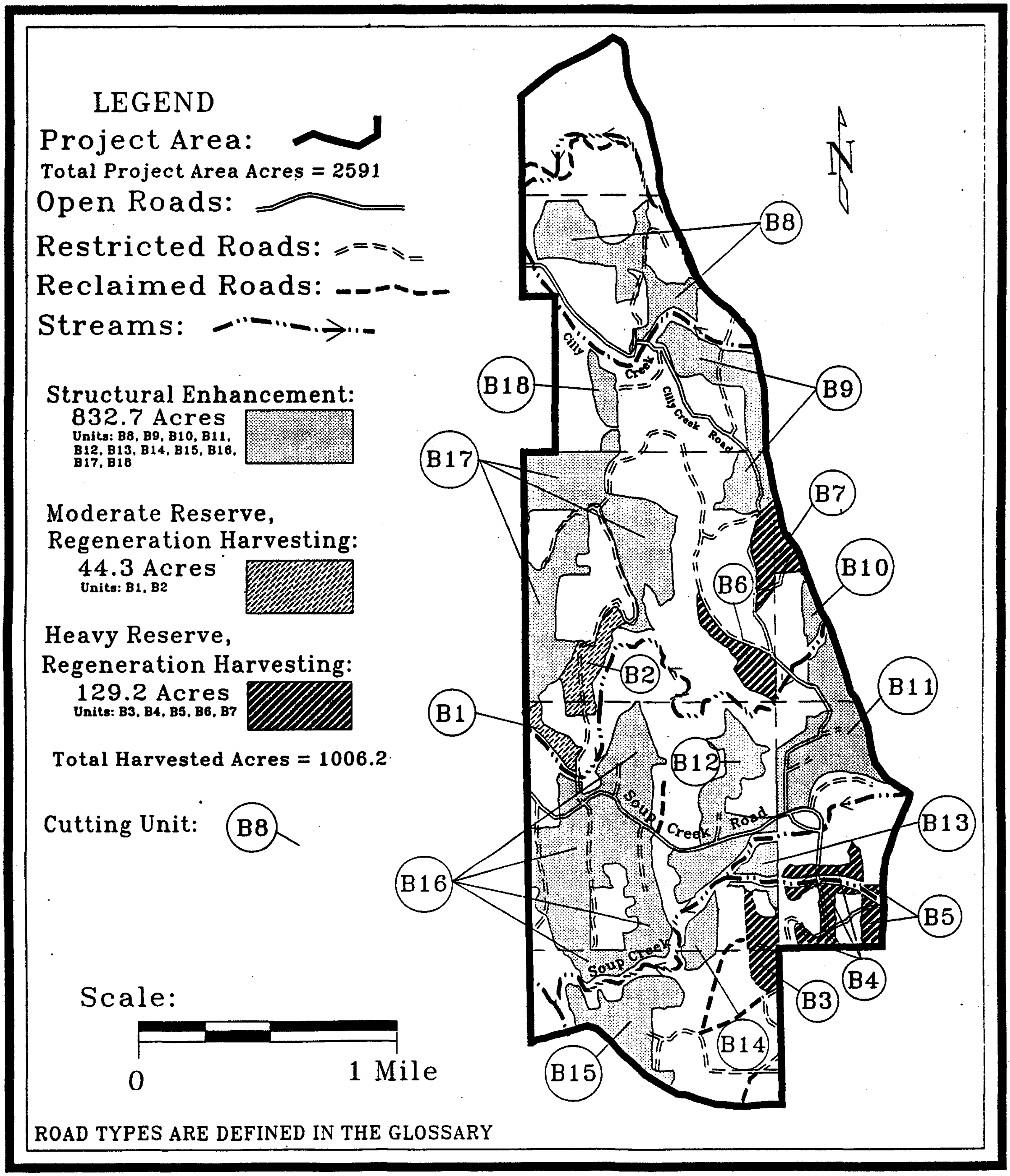


Figure 2.2

3. Mitigation measures

Under Alternative B, the following activities would be accomplished: Motorized traffic on portions of the Upper Soup Creek Canyon and Cilly Ridge roads would be restricted (reducing open road density), potential sediment source sites would be mitigated, in-stream rehabilitation projects would be completed, existing roads would be maintained, and noxious weeds would be prevented and controlled.

C. Alternative C: Old-growth Preservation

1. Summary

Alternative C attempts to resolve the old-growth preservation major resource concern. Timber harvesting would not occur in old growth but would occur in one saw-timber stand and one multistoried stand.

Deferring timber harvesting within old-growth stands would allow all existing old growth to be used as an outdoor classroom. This alternative use of school trust lands might allow students to experience varying stages of natural forest succession in the absence of human disturbance. The economic value of this use was not estimated in the economic analysis in Chapter IV.

2. Methods

Approximately 150,000 board feet (150 MBF) would be harvested on 62.5 acres. The 49.6-acre, saw-timber stand would receive heavy-reserve, regeneration harvesting. The 12.9-acre, multistoried stand would receive moderate-reserve, regeneration harvesting. Figure 2.3 shows the location of the cutting units and the type of treatment each cutting unit would receive.

Conventional tractor-logging methods would be used to treat the 12.9-acre stand (cutting unit C1). The tractor size would not exceed the equivalent of a JD 650C/D6D track-type tractor or a JD 540/518C rubber-tired skidder (machines that do not exceed nine feet in width and twenty feet in length). These limitations provide maneuverability that protects remaining trees and limits soil compaction.

Helicopter logging would be conducted to treat the 49.6-acre stand (cutting unit C2) because the existing road accessing cutting unit C2 is not maintained due to wetland crossings, and a new road would compromise adjacent old growth.

MIDDLE SOUP EIS

FIGURE 2.3 ALTERNATIVE C CUTTING UNITS

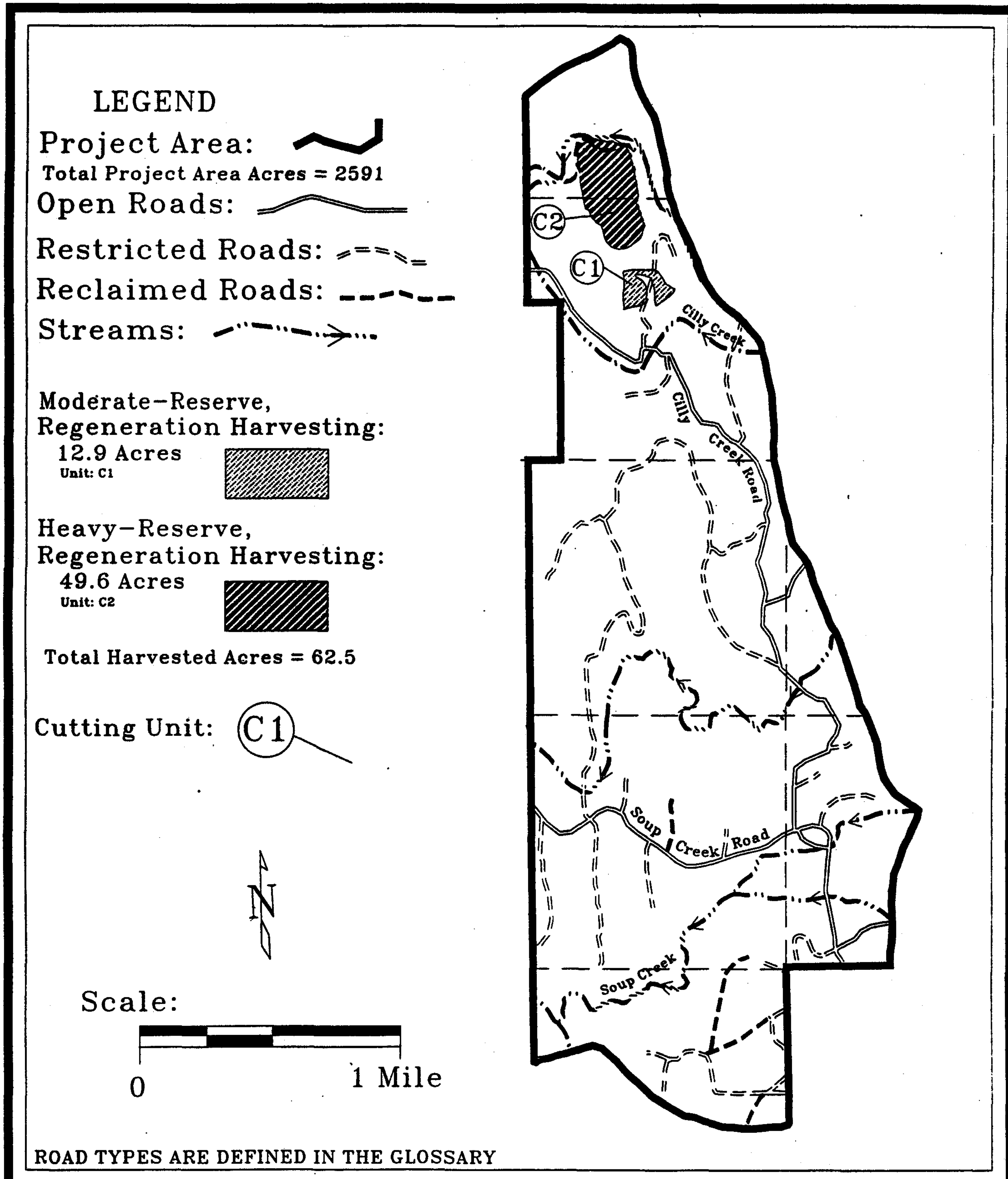


Figure 2.3

3. Mitigation measures

Under Alternative C, the following activities would be accomplished: Motorized traffic on portions of the Upper Soup Creek Canyon and Cilly Ridge roads would be restricted (reducing open road density), potential sediment source sites would be mitigated, in-stream rehabilitation projects would be completed, existing roads would be maintained, and noxious weeds would be prevented and controlled.

D. Alternative D: Timber Productivity

1. Summary

Alternative D attempts to resolve the timber productivity major resource concern. Treatments would be focused on optimizing timber productivity in old-growth, saw-timber, and multistoried stands identified as "high risk" or "low risk" in the SRSF Stand Level Inventory.

2. Methods

Approximately 5.6 MMBF would be harvested on 323.7 acres.
Light-reserve, regeneration harvesting would be applied to cutting units D1 and D2 totaling 11.2 acres. Moderate-reserve, regeneration harvesting would be applied to cutting units D3 through D7 totaling 88.3 acres. Heavy-reserve, regeneration harvesting would be applied to cutting units D9 and D10 totaling 224.2 acres. Figure 2.4 shows the location of the cutting units and the type of treatment each cutting unit would receive.

Conventional tractor-logging methods would be used. The tractor size would not exceed the equivalent of a JD 650C/D6D track-type tractor or a JD 540/518C rubber-tired skidder (machines that do not exceed nine feet in width and twenty feet in length). These limitations provide maneuverability that protects remaining trees and limits soil compaction.

3. Mitigation measures

Under Alternative D, the following activities would be accomplished: Motorized traffic on portions of the Upper Soup Creek Canyon and Cilly Ridge roads would be restricted (reducing open road density), potential sediment source sites would be mitigated, in-stream rehabilitation projects would be completed, existing roads would be maintained, and noxious weeds would be prevented and controlled.

MIDDLE SOUP EIS

FIGURE 2.4 ALTERNATIVE D CUTTING UNITS

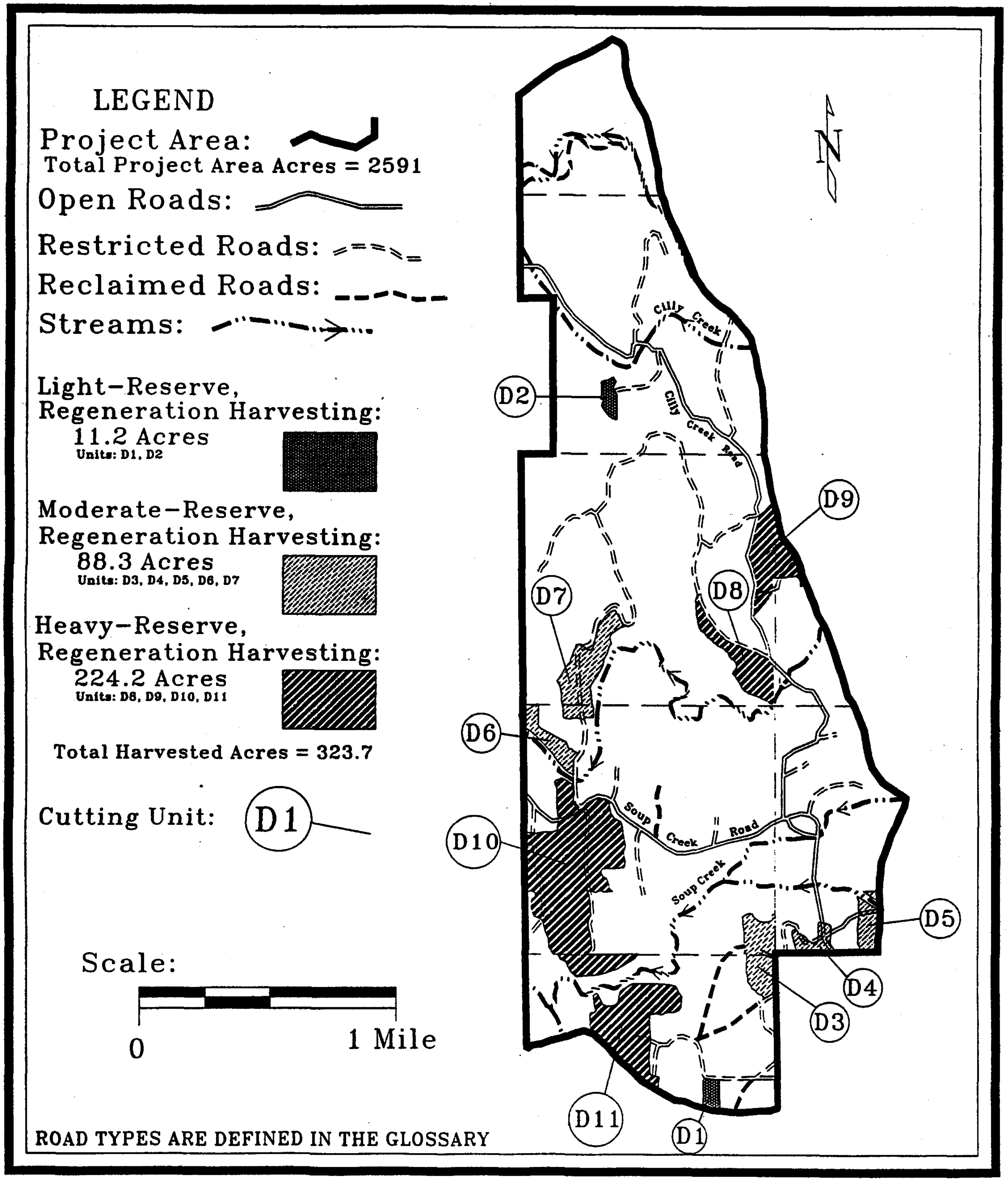


Figure 2.4

IV. SUMMARY OF EFFECTS

The following table compares the alternatives by summarizing their environmental consequences. The table lists the major resource concerns in the left-hand column and compares the related effects for each alternative in the remaining columns. The scientific basis for the environmental effects summarized here is discussed in more detail in Chapter IV. Readers should refer to Chapter IV for a complete understanding of the terms, quantities, and statements presented here.

Table 2.1 ***Summary of Effects*** (continued on the following pages)

Resource Concerns	Alternatives			
Ecosystem Sustainability	**A**	**B**	**C**	**D**
1. Conserving mature forest	Short-term increase in mature forest; long-term decrease in mature forest.	Short-term decrease in mature forest; long-term increase in mature forest.	No change in mature forest in short term; long-term decrease in mature forest.	Short- and long-term decrease in mature forest.
2. Reducing habitat fragmentation	Short-term decrease in fragmentation; long-term increase in fragmentation.	Short- and long-term decrease in fragmentation.	Short-term and long term increase in fragmentation.	Short-term and long-term increase in fragmentation.
3. Maintaining structural complexity and diversity.	Short-term increase in structural complexity and diversity; long-term decrease in structural complexity and diversity.	Short-term and long-term increase in structural complexity and diversity.	No change in short-term diversity. Short-term and long-term decrease in structural complexity. Long-term decrease in diversity.	Short-term and long-term increase in structure complexity and diversity.

Old-Growth Preservation	A	B	C	D
1. Short- and long-term effects (% of existing old-growth acres in the project area).	100% of old growth preserved for short term; 71.4% preserved for long term.	88.3% of old growth preserved for short term; 81.9% preserved for long term.	100% of old growth preserved for short term; 71.4% preserved for long term.	77.6% of old growth preserved for short term; 55.3% preserved for long term.
2. General effects immediately post-harvest (% of existing old-growth acres).	No reduction in existing old growth in the watersheds or SRSF.	Old growth in watersheds reduced from 48.9% to 47.6%; old growth in SRSF reduced from 36.4% to 36.0%.	No reduction in existing old growth in the watersheds or SRSF.	Old growth in watersheds reduced from 48.9% to 46.4%; Old growth in SRSF reduced from 36.4% to 35.7%.
Timber Productivity (% of project area)	14.2% having optimum productivity; 39.5% having positive productivity; 28.1% having zero productivity; 18.2% having negative productivity.	15.9% having optimum productivity; 39.3% having positive productivity; 37.8% having zero productivity; 7% having negative productivity.	14.7% having optimum productivity; 40.8% having positive productivity; 26.4% having zero productivity; 18.2% having negative productivity.	18% having optimum productivity; 40.2% having positive productivity; 26.8 percent having zero productivity; 15% having negative productivity.

Resource Concerns	Alternatives			
Grizzly Bear	**A**	**B**	**C**	**D**
1. Open Roads (% entire subunit > 1.0 mi/ mi^2)	Remain at 34%.	Reduced to 28%.	Reduced to 28%.	Reduced to 28%.
2. Open Roads (% DNRC acres > 1.0 mi/mi^2)	Remain at 43%.	Reduced to 34%.	Reduced to 34%.	Reduced to 34%.
3. Total Roads (% entire subunit > 2.0 mi/mi^2)	Remain at 43%.	Remain at 43%.	Remain at 43%.	Remain at 43%.
4. Total Roads (% DNRC acres > 2.0 mi/mi^2)	Remain at 52%.	Remain at 52%.	Remain at 52%.	Remain at 52%.
5. Security Habitat (entire subunit)	Remain at 38%.	Remain at 38%.	Remain at 38%.	Remain at 38%.
6. Security Habitat (DNRC acres)	Remain at 28 %.	Remain at 28 %.	Remain at 28 %.	Remain at 28 %.
7. Hiding Cover (entire subunit)	Remain at 79%.	Remain at 79%.	Remain at 79%.	Remain at 79%.
8. Hiding Cover (DNRC acres)	Remain at 91%.	Remain at 91%.	Remain at 91%.	Remain at 91%.
Elk	**A**	**B**	**C**	**D**
1. Open Roads	Remain at 1.2 miles per square mile.	Remain at 1.2 miles per square mile.	Remain at 1.2 miles per square mile.	Remain at 1.2 miles per square mile.
2. Hiding Cover	Remain at 90.9%.	Reduced to 90.1%.	Reduced to 90.7%.	Reduced to 89.2%.
3. Thermal Cover	Remain at 61.2%.	Reduced to 60.4%.	Reduced to 61.0%.	Reduced to 59.5%.
4. Forage Area	Remain at 26.2%.	Increased to 26.9%.	Increased to 26.4%.	Increased to 27.9%.
5. Security Area	Remain at 26.7%.	Remain at 26.7%.	Remain at 26.7%.	Remain at 26.7%.
6. Habitat Potential	Remain at 50%.	Remain at 50%.	Remain at 50%.	Remain at 50%.

Resource Concerns	Alternatives			
White-Tailed Deer	**A**	**B**	**C**	**D**
1. Hiding Cover	Remain at 90.9%.	Reduced by 44.3 acres (less than 1%).	Reduced by 12.9 acres (less than 1%).	Reduced by 99.5 acres (1.7%).
2. Foraging Area	Remain at 26.2%.	Increased to 26.9%.	Increased to 26.4%.	Increased to 27.9%.
3. Thermal Cover	Remain at 61%.	Reduced to 60.4%.	Remain at 61%.	Reduced to 59.5%.
Cavity-Dependent Wildlife	Habitat quality would remain high.	Minimal negative impacts; Possible long-term benefits.	Some moderate negative impacts; Possible long-term benefits.	Some substantial negative impacts; Some moderate negative impacts.
Aesthetics	No change.	Visual resource reduced substantially on 44.3 acres; moderately on 129.2 acres; slightly on 832.7 acres.	Visual resource reduced substantially on 12.9 acres; moderately on 49.6 acres.	Visual resource reduced substantially on 99.5 acres; moderately on 224.2 acres.'
Water Quality	**A**	**B**	**C**	**D**
1. Annual Runoff of Soup Creek Watershed	Remain at existing 1% increase over modeled natural conditions.	Remain at existing 1% increase over modeled natural conditions.	Remain at existing 1% increase over modeled natural conditions.	Remain at existing 1% increase over modeled natural conditions.
2. Annual Runoff of Cilly Creek Watershed	Remain at existing 3% increase.	Remain at existing 3% increase.	Remain at existing 3% increase.	Remain at existing 3% increase.
3. Annual Sediment of Soup Creek Watershed	Remain at 18% increase with zero accumulation.	Increase to 27% with zero accumulation.	Remain at 18% increase with zero accumulation.	Increase to 27% with zero accumulation.
4. Annual Sediment of Cilly Creek Watershed	Remain at 44% increase with zero accumulation.	Remain at 44% increase with zero accumulation.	Decreased to 35% over modeled natural conditions with zero accumulation.	Remain at 44% increase with zero accumulation.
5. Existing Erosion Sources	Erosion sources not mitigated.	Erosion sources inventoried and mitigated.	Erosion sources inventoried and mitigated.	Erosion sources inventoried and mitigated.

6. SMZ Cutting Units	No Harvest Activity in SMZ.	No Harvest Activity in SMZ. All units set away from SMZ boundary due to Bull Trout Immediate Actions.	No Harvest Activity in SMZ. All units set away from SMZ boundary due to Bull Trout Immediate Actions.	No Harvest Activity in SMZ. All units set away from SMZ boundary due to Bull Trout Immediate Actions.
Resource Concerns	**Alternatives**			
Fisheries	No change to fisher-ies from current con-dition. No additional habitat monitoring.	Low potential risk to fishery habitat and population. Continue monitoring fish habi-tat as recom-mended by MFWP.	Low potential risk to fishery habitat and population. Continue monitoring fish habi-tat as recom-mended by MFWP.	Low potential risk to fishery habitat and population. Continue monitoring fish habi-tat as recom-mended by MFWP.
Air Quality	No change to exist-ing air quality.	Burning on 173.5 acres; Moderate de-crease in air quality lasting a few days.	Burning on 62.5 acres; Slight decrease in air quality lasting a few days.	Burning on 323.7 acres; decrease in air quality lasting a few days.
Soils	**A**	**B**	**C**	**D**
1. Soil Erosion Potential	Existing erosion potential would remain unchanged.	Decreased erosion potential by implementing mitigation.	Decreased erosion potential by implementing mitigation.	Decreased erosion potential by implementing mitigation.
2. Soil Impacts: Displacement and Compaction	No change in existing compaction, 10-15% of the area in old skid trails and landings	Mitigation measures would limit impacts to less than 15% of the project area. Less than 23 acres severely impacted with skid trails and landings.	Mitigation measures would limit impacts to less than 15% of the project area. Less than 5 acres severely impacted with skid trails and landings.	Mitigation measures would limit impacts to less than 15% of the project area. Less than 23 acres severely impacted with skid trails and landings.
Noxious Weeds	No treatment, continued spread on roads.	Implement weed control and grass seeding.	Implement weed control and grass seeding.	Implement weed control and grass seeding.
Gray Wolves	**A**	**B**	**C**	**D**
Road Density (analysis area)	Remain at 1.2 miles/square mile.	Remain at 1.2 miles/square mile.	Remain at 1.2 miles/square mile.	Remain at 1.2 miles/square mile.

Treatment	Alternatives			
Road System	**A**	**B**	**C**	**D**
Road Construction	None	None	None	None
Road Closure	None	1.8 miles of Upper Soup Creek Canyon Road and 1.7 miles of Upper Cilly Ridge Road closed.	1.8 miles of Upper Soup Creek Canyon Road and 1.7 miles of Upper Cilly Ridge Road closed.	1.8 miles of Upper Soup Creek Canyon Road and 1.7 miles of Upper Cilly Ridge Road closed.
Road Maintenance	None	12 miles of ditch-pulling, surface-grading, culvert-cleaning and noxious weed control.	12 miles of ditch-pulling, surface-grading, culvert-cleaning and noxious weed control.	12 miles of ditch-pulling, surface-grading, culvert-cleaning and noxious weed control.
Logging Method	**A**	**B**	**C**	**D**
Tractor (acres)	None	1006.2	12.9	323.7
Helicopter (acres)	None	None	49.6	None
Harvest Method	**A**	**B**	**C**	**D**
Light-Reserve	None	None	None	11.2
Moderate-Reserve	None	44.3	12.9	88.3
Heavy-Reserve	None	129.2	49.6	224.2
Structural Enhancement	None	832.7	None	None
Brush Disposal	**A**	**B**	**C**	**D**
Excavator Pile and Burn (acres)	None	173.5	62.5	323.7
Lop and Scatter (acres)	None	832.7	None	None

Treatment	Alternatives			
Tree Regeneration	**A**	**B**	**C**	**D**
Interplant WWP at 200 trees/acre	None	44.3	12.9	99.5
Interplant WWP at 100 trees/acre	None	129.2	49.6	224.2
General Information	**A**	**B**	**C**	**D**
Total Acres Treated	None	1006.2	62.5	323.7
Total Volume (MBF)	None	5,177	150	5,631
Season of Harvest	None	Winter	Winter	Winter

V. RECOMMENDED ALTERNATIVE

The ID team recommends Alternative B to the decision maker as its preferred alternative. The ID team believes that Alternative B would best meet the Middle Soup Creek Project objectives while maintaining the long-term ecosystem sustainability of the project area lands. Alternative B would also best meet the biodiversity management philosophy of the SFLMP. The following specific reasons were given for recommending Alternative B as the preferred alternative:

1. Alternative B would meet the project objectives while improving timber productivity on the largest number of acres.

2. Alternative B would employ less intense silvicultural treatment over a large area instead of intense treatment on a relatively small area.

3. Alternative B would begin to restore historic patterns of forest patch size and maintain forest corridors across the land.

4. Alternative B would best mitigate concerns about cavity-dependent wildlife.

5. Alternative B would maintain the greatest flexibility for future management options.

CHAPTER III

EXISTING ENVIRONMENT

Environmental Characteristics, Analysis Areas, and Analysis Methods

INTRODUCTION

Chapter III provides the basis for analyzing the environmental consequences of the alternatives. In addition to describing the existing environmental characteristics that are important to the analysis of resource concerns, it delineates analysis areas, and explains analysis methods where appropriate.

I. EXISTING ENVIRONMENT RELATIVE TO ECOSYSTEM SUSTAINABILITY

A. Historic Conditions in Forests of the Swan Valley

1. General conditions

The Swan River State Forest (SRSF) contains some of the largest remaining tracts of undisturbed mature forest representative of the Swan Valley ecosystem as it existed before significant human exploitation began several decades ago. Although these forests are undisturbed in the sense that they have not had any significant quantities of timber removed, they are not entirely pristine. Active fire suppression began well before commercial exploitation in the Swan Valley so even unharvested forests are not natural in the sense that their structure and composition reflects the absence of natural disturbance for more than 50 years (Antos and Habek 1981, Freedman and Habeck 1984, Habeck 1988).

Since significant timber harvesting in the Swan Valley began in the 1960's, the total area of mature forest remaining has been substantially reduced (Hart 1994, Fig. 1). More importantly, fragmentation of the remaining forest has increased more than two-fold, resulting in a large number of smaller, more uniformly sized timber patches with significantly less core area (Hart, 1994).

Further reduction of total mature forest area and increased fragmentation of remaining forest patches could threaten ecosystem integrity and create several unresolvable conflicts. Loss of effective old forest habitat could eventually eliminate plant and animal communities that are old-growth associated. Not only would species now considered sensitive, threatened, or endangered suffer, but many less obvious species would be reduced to non-sustainable population densities with the elimination of old forest habitats. The effectiveness of the Swan Valley forest ecosystem to act as a corridor between the Mission and Swan Mountains would be compromised. Ultimately, the shift in community balance from mostly old forest to open, early successional communities would significantly change the nature of the biotic communities compared with historic patterns.

2. Historic fire regimes

Historically, fire exercised an influential role over the characteristics of forested landscapes in the Swan Valley, as it did over most of forested western Montana. Fire regimes varied, depending on micro-site conditions, from infrequent, stand-replacing burns, through intermediate frequency, intermediate intensity burns, to frequent, thinning underburns. However, the latter type appears to have been restricted to the upper portion of the Swan River drainage, south of the SRSF.

Hart (1994:36) summarized the historical data as follows:

> *"...Although most of the burns...were of stand-replacement intensity, many less intense fires had also crept over wide areas. The upper* [i.e., southern*] half of the Swan Valley had been extensively burned, and was blanketed by fallen trees. In this area, fires were moderate, thinning the forest. The lower* [i.e., northern] *Swan also was scarred by fires, but it had a great deal of older mixed forest; species typical of mesic sites were found in this region...".*

Antos and Habeck (1981), working mostly in the northern portion of the Swan Valley, emphasized the dominance of low-frequency, high-intensity fires (i.e., "stand-replacement fires") in determining stand patterns:

> *"During most summers, the occurrence of frequent rain makes intense fires unlikely; but in some years, dry summers set the stage for large crown fires. Most stands were initiated on large burns....an average frequency of replacement burns of between 100 and 200 years was characteristic...Stands over 300 years old do occur, and repeat burns less than 20 years apart have also occurred. In some forests initiated by replacement burns, ground fires have occurred after stand establishment, with variable effects on the overstory. Very wet sites such as stream bottoms and lower north slopes often experience partial burns when located within the perimeter of large replacement*

burns".(Antos and Habeck 1981:29)

Freedman and Habeck (1984), who worked primarily in drier forests south of the project area but as far north as Goat Creek in the SRSF, emphasized the role of rather more frequent burns in the southern portion of the Swan Valley, while agreeing with Antos and Habeck (1981) that fire frequency decreased with latitude:

"...wildfire was commonplace in the Swan Valley. Fire-scarred ponderosa pines, charcoal in the soil layers, and the occurrence of even-aged stands of lodgepole pine...attest to the past presence of fire; the relative scarcity of old-growth climax forests provides further insight into the influence of historic fire".(Freedman and Habeck 1984:24)

"Our fire history analysis indicates that the [lower elevation portions of the Swan Valley] *was burned frequently; in the drier southern half..the intervals were shorter than on the more moist northern part. Between 1758 and 1905 this portion of the range had fire-free intervals of about 30 years, and the presence of western larch and even-aged lodgepole pine suggests the fires here were of higher intensity..The remaining samples are from the southern end* [i.e., south of the Project Area], *and these have a shorter interval of 17 years."*(Freedman and Habeck 1984: 27)

3. Historic abundance of older forest types

There exists no single, unambiguous way to estimate the historic amounts of older forests and/or old growth (in part because definitions of "old growth" are not consistent among investigators). However, we can provide an approximation based on the work of Losensky (1993), Lesica (1996), USDA Forest Service, Flathead National Forest (1992), and Hart (1994).

Losensky (1993) estimated percentages of area by age class in the year 1900, using adjustments to 1930's forest inventory information. He provided estimates broken down by forest cover types, and reported both by defined "climatic sections" as well as western Montana averages. His estimates for the western white pine and larch/Douglas fir cover types that are most typical of lower elevation areas within the SRSF indicates that roughly one-half of the forested area existed as mature and/or old growth (Table 3.1).

Table 3.1 ***Proportions of each forest cover type in various age-classes, both within the climatic section corresponding to the SRSF, and for western Montana averaged over all cover types (Losensky 1993).***

	Upper Flathead (Climatic Section 12)		**Western Montana Average**	
Age/size classes	western white pine	Douglas-fir western larch	western white pine	Douglas-fir western larch
Nonstocked	11.7	11.4	22.8	18.2
Seedling/sapling	9.7	18.8	23.2	19.1
Poles	1.2	5.6	3.8	5.9
Immature	6.4	9.8	6.8	7.3
Mature	51.0	17.8	22.5	18.2
Old Growth	21.8	36.6	20.8	31.3

Lesica (1996) took a different approach to estimating the proportions that would generally occur within age-class intervals, based on mean fire-free intervals. He found that negative-exponential distributions adequately fit observed frequencies for a number of forests. Using an assumed 150-year mean fire-free interval (i.e., interpolating from Antos and Habeck's [1981] "average frequency of replacement burns of between 100 and 200 years"), the distribution in Table 3.2 results, presented from oldest to youngest classes.

The Flathead National Forest (USDA Forest Service, Flathead National Forest 1992) used data from an 1898-99 survey of the area by H.B. Ayers to estimate the amount of mature forest existing at the turn of the century, concluding:

> *"The Swan Valley contained the highest proportion (9 percent) of the high-volume timber class (5-10 MBF/acre) of the areas surveyed on the Forest. About 40 percent of the area was occupied by mature and older forests."* (USDA Forest Service, Flathead National Forest 1992:III-6)

Finally, Hart (1994:54), noting that considerable potential for bias existed in estimating proportions of "old growth" existing historically, estimated the proportion of 200+ year stands at just under 30% of the total Seeley-Swan landscape (including areas south of the SRSF) during the 1930's, or approximately 48% of forested stands in which age information had been recorded. Taken together, estimates of old-growth fraction in Swan Valley forests prior to active management vary from about 25 to 50 percent of the forested ecosystem.

Table 3.2 ***Proportions by age-classes resulting from application of the negative exponential model, using an assumed stand-replacement interval of 150 years (Lesica 1996).***

Age Class	Proportion in Class	Cumulative Proportion
200+	26.4	26.4
181 - 200	3.8	30.2
161 - 180	4.3	34.5
141 - 160	4.9	39.4
121 - 140	5.6	45.0
101 - 120	6.4	51.4
81 - 100	7.3	58.7
61 - 80	8.4	67.1
41 - 60	9.6	76.7
21 - 40	10.9	87.6
1 - 20	12.5	100.0

4. Historic juxtaposition of landscape characteristics
Fewer data are available with which to assess the historic juxtaposition of habitat types and patches. However, Hart, (1994:37), concluded that:

"...the managed landscape of the 1990's exhibits different patterns than the more natural 1930's landscape, including smaller and more numerous patches with more edge and less interior habitat.",

and later (Hart 1994:35), that:

"The major differences in the landscapes for the two time periods -- number of patches, mean patch size, and mean core area index -- suggest a more fragmented landscape in the 1990's than existed in the 1930's."

Specifically, Hart's (1994) analysis suggested that, within her entire Seeley-Swan study area, the number of patches had increased, patch sizes had decreased but become more uniform, patch shape had become more complex, and edge had increased at the expense of patch interior compared to conditions during the 1930's (Table 3.3).

Table 3.3 ***Selected landscape metrics comparing 1930's to 1990's conditions in the entire Seeley-Swan valley. Data taken from Hart (1994:66). All distinct patches (mapped at 16 ha minimum mapping unit) were assessed. Shape index is calculated relative to the simplest shape, i.e. a perfect square which takes the minimum value, 1.0 (more complex shapes take larger values).***

Landscape Measure	1930's	1990's
Number of patches	1,320	3,370
Mean patch size (ha)	187.82	73.57
Patch size standard deviation	728.25	291.43
Mean shape index	1.90	2.35
Total edge (km)	5,972	13,278
Patch interior (km^2), i.e., core	1,974	1,491

5. Historic levels of structural and compositional diversity

The structure and composition of forests in the Swan Valley appears atypical of historic conditions. Active fire suppression since the 1940's has led to substantial filling-in of forest stands throughout the Swan Valley. The chief responses of the forest stands in the Soup and Cilly watersheds to the changes in disturbance regime have been an increase in the number of seedling and sapling stands as well as greatly increased tree density (stocking rates) in undisturbed stands. Comparisons of stand densities before fire suppression with present conditions suggest that the fraction of the forest showing greater than 60% canopy closure has more than doubled while the fraction with less than 29% canopy closure has been reduced by half (Hart 1994:57). Hart (1994:37) summarized the situation:

"Individual stands have become more dense and fuels have accumulated as fires have been suppressed".

Hart (1994:35) also pointed out that cover types had changed with continued fire suppression, as well as the introduction of exotic pathogens:

"Coupled with...structural differences are differences in composition, or in proportion of the landscape occupied by each cover type. Such differences are likely to have important implications for landscape function".

Douglas-fir has succeeded ponderosa pine in drier areas, increasing the area of mature and over-mature Douglas-fir at the same time as mature ponderosa pine has decreased. In moister areas, western white pine, western larch, and red-cedar have declined (the former primarily due to disease), giving way to Englemann spruce and subalpine fir.

B. Current Conditions: Analyses

Here, we perform our own analyses to estimate the current condition of forests within the immediate environs of the project area, and/or the entire SRSF (depending on analysis) relative to the three components of ecosystem sustainability: I) amount of mature forest, ii) spatial (landscape) characteristics, and iii) diversity of structural and compositional components.

1. Analysis areas

In order to assess both the quantity of specified forest attributes and their spatial juxtaposition, we required designation of an analysis area that was larger than the Mid-Soup Creek Project Area (MSPA). Had we limited our analysis only to the MSPA, many forest patches would be both inside and outside the area, and problems of interpreting edges and boundaries would have been considerable. Thus, we identified a slightly larger area for purposes of assessing ecosystem sustainability, which we have termed the "ecosystem sustainability analysis area" (ESAA) . Th ESAA includes the entire MSPA, but extends it out to the boundaries of each section (Fig. 3.1), and totals 8,077 acres. Using the ESAA reduces (but does not entirely eliminate) distortions caused by inevitable "edges" within the chosen analysis area. In assessing the abundance of mature forest types, we were also able to provide estimates of current conditions on the entire DNRC holdings within the Swan River State Forest (SRSF).

2. Conserving mature forest

a. Methods

All DNRC forested stands were categorized as 1 of 8 tree size classes (see glossary size class definitions): old growth (OLDGR), saw timber other than old growth (SAW), multi-storied (MULTI), older pole timber (closed canopy; OPOLE), young pole timber (closed canopy; YPOLE), sapling and young pole timber (open canopy; SAP), grass/shrub/seedling (G/S/S), and non-forested areas (NFOR). For purposes of assessing ecosystem sustainability, old growth and saw timber categories were considered to represent mature forest types, while the remaining forested categories were immature, successional forest types.

b. Results

For the entire SRSF, acreage within these 8 vegetative categories is distributed among 792 discrete parcels. Of 39,848 acres of DNRC-owned land within the SRSF, 37,408 acres (94%) are currently classified as forested habitat. In all,

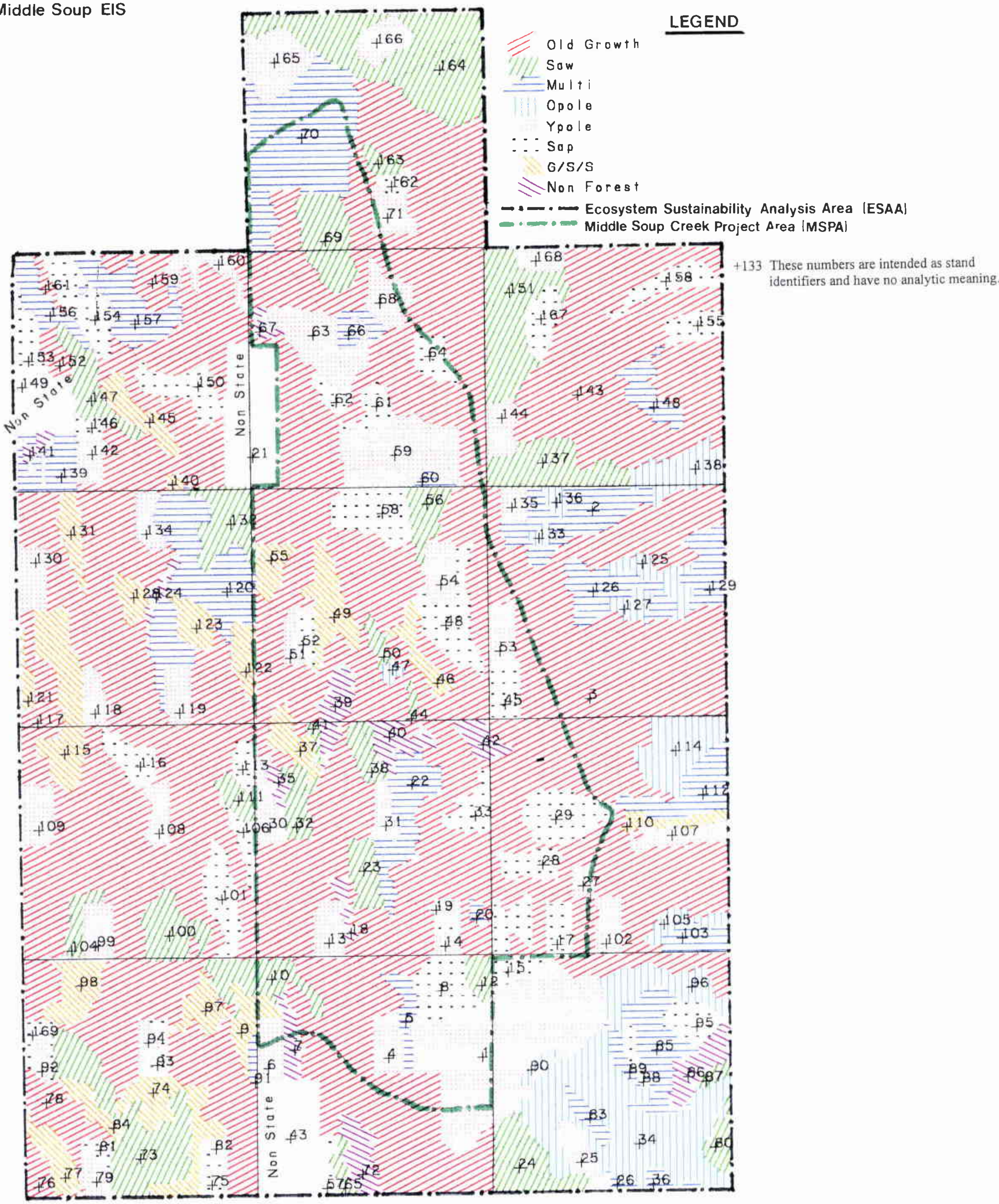


FIGURE 3.1

Current Condition 4/10/96

21,715 acres of forest (54%) are classified as mature and 18,133 acres (46%) are immature. Fully 14,506 acres (39%) of forest stands are classified by DNRC as old growth, 40% of which (5,847 acres) are found within the Soup/Cilly Creek drainages and form a significant portion of the proposed sale area.

Within the ESAA, 4,679 acres (57.9%) are classified as mature. Of these, some 3,868 (47.9% of the ESAA) are classified as old growth (Fig. 3.1).

3. Spatial characteristics of forested patches

a. Methods
We first determined unique forest patches by merging all adjacent forest stands with the same tree-size class. (The stand-level inventory assigns unique identifiers to stands within each legal section, regardless of whether doing so creates artificial boundaries in otherwise continuous landscape patches. Our procedure simply reproduced patches as they actually occur on the ground). We assessed spatial characteristics of the resulting patches using two categorization systems: I) the 8 tree-size classes, earlier described, and ii) a "merged" tree-size classification, in which old-growth, saw-timber, and -- if present, post-old-growth stands were considered as the"mature" tree-size classification, multi-storied, old-pole, young-pole, and sapling stands were considered as the "immature" tree-size classification, and the grass/shrub/seedling category was combined with the naturally non-forested category into a "non-forest" tree-size classification.

Mean and standard deviation of patch size were calculated directly using the PAMAP GIS system. As an index to patch shape, we used the shape index of McGarigal and Marks (1994: C5), which uses both perimeter and area of each patch, but corrects for the effects of patch size. This index, also used by Hart (1994) and presented above in Table 3.3, takes a minimum value of 1.0 when patches are exactly square, and increases with shape complexity. We assessed the spatial juxtaposition of patches by tallying the amount of perimeter of each patch with patches of each other class. We then compared these "adjacency" proportions to those that would hold if all types of adjacency occurred in proportion to the abundances of the tree-size classes. Positive values here indicated that these types of juxtapositions were more common than would be expected based on abundance of types alone, while negative values indicated that these types of juxtapositions were rarer than might be expected. These calculations asked whether contrasts between patch types were greater or smaller than would be expected based on the abundance of the patch types alone.

Finally, we assessed the amount of "core interior" forest habitat by buffering all patches classified as one of the three "mature" types by 100 meters, and then summing only those in which the buffered area exceeded 50 hectares (123.5 acres).

b. Results

Within the ESAA, overall mean patch size is 49.3 acres. However, this figure is highly influenced by a single large patch of 3,371 acres. This large "patch" forms the background upon which all others are laid, and could equally easily be considered the landscape "matrix" (Forman and Godron 1986:159). As well, most of this patch is located outside of the Project Area per se. If this patch is excluded, overall mean patch size within the ESAA drops to 28.9 acres. Of the total 164 patches within the ESAA, 145 (88%) are less than 50 acres in size, and fully 96% (157) are less than 100 acres in size (Fig. 3.2). Mean patch size is largest for the old-growth tree-size class (484 acres), but again, this includes the large "matrix" patch. If this large patch is excluded, mean size for the remaining 7 old-growth patches drops to approximately 71 acres. Mean patch size for the remaining tree-size classes are in the 20-30 acre range. Patch sizes are also relatively uniform, with standard deviations roughly equal to means (Table 3.4a).

Patch sizes are somewhat larger when patches are classified by the merged types "mature", "immature", and "nonforested". Mean patch size across all types is 101 acres, again, largest in the mature types (Table 3.4b).

FIGURE 3.2

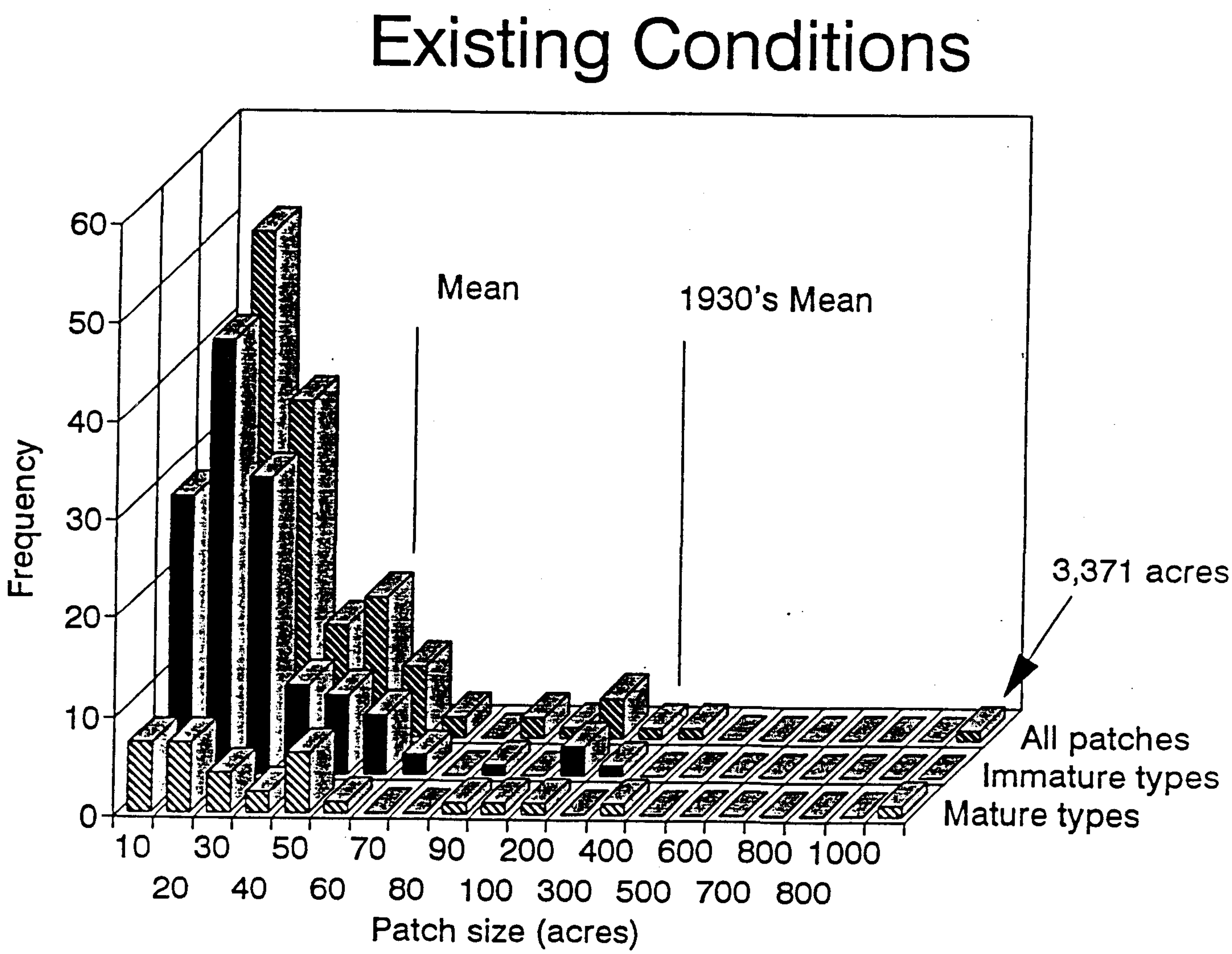

Existing Conditions
Frequency
60
50
40
30
20
10
0
Mean
1930's Mean
3,371 acres
All patches
Immature types
Mature types
10 30 50 70 90 200 400 600 800 1000
20 40 60 80 100 300 500 700 800
Patch size (acres)

Table 3.4 ***Forest characteristics existing within the Ecosystem Sustainability Analysis Area (ESAA), by tree-size class. Shown are total and proportion acreage, number of patches, mean and standard deviation of patch size, and shape indices for each class.***

a. Classified by tree-size class.

	--- Mature --		------ Pole ------					
Characteristic	OG	Saw timber	Multi	Old	Young	Sapling	G/S/S	Nonforest
Total Acreage	3868	811	785	393	926	669	453	172
Proportion of ESAA	0.48	0.10	0.10	0.05	0.12	0.08	0.06	0.02
Number of patches	8	24	22	11	36	33	19	11
Mean patch size (acres)	484	34	36	36	26	20	24	16
Standard deviation: patch size	1097	34	36	51	26	11	15	7
Shape Index	2.37	1.38	1.57	1.36	1.21	1.30	1.43	1.46

b. Classified by merged tree-size classes.

Characteristic	Mature	Immature	Nonforest
Total Acreage	4679	2772	626
Proportion of ESAA	0.58	0.34	0.08
Number of patches	8	45	27
Mean patch size (acres)	585	62	23
Standard deviation: patch size	1503	110	15
Shape Index	2.30	1.34	1.49

Adjacency among tree-size classes is presented in Table 3.5. In general, old growth and saw timber types have greater adjacency to the early seral types and less with each other than would be expected, given the existing abundances of each type (Table 3.5b). For example, there is roughly 4% less adjacency with saw timber among old-growth patches, and 7% more adjacency with both sapling and grass/shrub/seedling patches than would be expected given their abundances. This general pattern, of older patches being disproportionately close to younger patches, is seen throughout the matrix. The result is that edges between patches tend to be more abrupt than would otherwise be the case.

The mean shape index for all stands within the ESAA is 1.41. This is lower than both the 2.35 estimated by Hart (1994) for all of the Seeley/Swan study area, as well as the 1.90 she estimated as characterizing the area during the 1930's. This suggests that, in general, patches in the ESAA are of simpler shape than historically, or in the Seeley/Swan as a whole. However, old growth patches are more complex than are patches of earlier seral stages: the mean index among old-growth stands is 2.37 (and the largest [i.e., "matrix"] patch of old growth has an index of over 7.7). The simpler shapes of earlier successional stages likely reflect the "square-ness" of cutting units. The picture is similar if viewing patches by the coarser "merged" stand-size classification (Table 3.4b). Mean shape index is 1.49, and mature patches are more complex (2.30) than either immature (1.34) or the merged grass/shrub/seedling-nonforest class (1.49). Thus, in general, mature patches have more complex shapes (i.e., have a greater amount of edge per amount of area), and early seral patches have simpler shapes (i.e., have a greater amount of area per amount of edge) than was historically the case.

A total of 1,594 of the 8,077 acres within the ESAA qualified by both our criteria of "mature" and "interior core". Of these, some 1,007 were also classified as "old growth". However, examination of Fig. 3.3 reveals that the majority of the "mature interior core" forest within the ESAA is located outside of the Project Area per se.

4. Structural and compositional diversity

a. Methods

We used existing stand-level inventory data to describe current conditions in terms of forest types (dominant species), overall stocking levels, and type of forest structure, on both the entire SRSF and the ESAA.

2. Results

Douglas-fir and western larch cover types constitute over 50% of the entire SRSF, and are somewhat more predominant within the ESAA. Over 63% of the ESAA is classified as either Douglas-fir, western larch, or a combination of the two (Table 3.6). Cedar, lodgepole pine, spruce, and subalpine fir types are slightly less common on the ESAA than they are in general within the SRSF.

Table 3.5 ***Adjacency matrices of tree-size classes within the Ecosystem Sustainability Analysis Area (ESAA). Columns are proportion of each size-class that border the class of that row, and hence sum to 1.0. Thus, for example, in Table 3.5a, 15.3% of the total perimeter around existing old growth borders saw timber, but 45.8% of the perimeter around saw timber borders old growth. The difference occurs because there is more old growth within the ESAA than there is saw timber.***

a. Classified by tree-size class.

	----- MATURE-----		--------POLE--------					
	OG	Saw timber	Multi	Old	Young	Sapling	G/S/S	Nonforest
OG	--	0.458	0.367	0.297	0.500	0.661	0.663	0.467
Saw timber	0.153	--	0.082	0.106	0.100	0.108	0.136	0.168
Multi-storied	0.134	0.089	--	0.435	0.123	0.084	0.080	0.220
Old Pole	0.050	0.053	0.203	--	0.056	0.013	0.000	0.003
Young Pole	0.203	0.121	0.137	0.133	--	0.169	0.071	0.102
Sapling	0.228	0.111	0.079	0.027	0.144	--	0.042	0.022
Grass/Shrub/Seed	0.176	0.107	0.058	0.000	0.046	0.032	--	0.018
Nonforest	0.057	0.061	0.073	0.002	0.031	0.008	0.008	--
	1.0	1.0	1.0	1.0	1.0	1.0	1.0	1.0

b. Differences from expected, based on existing abundances by type.

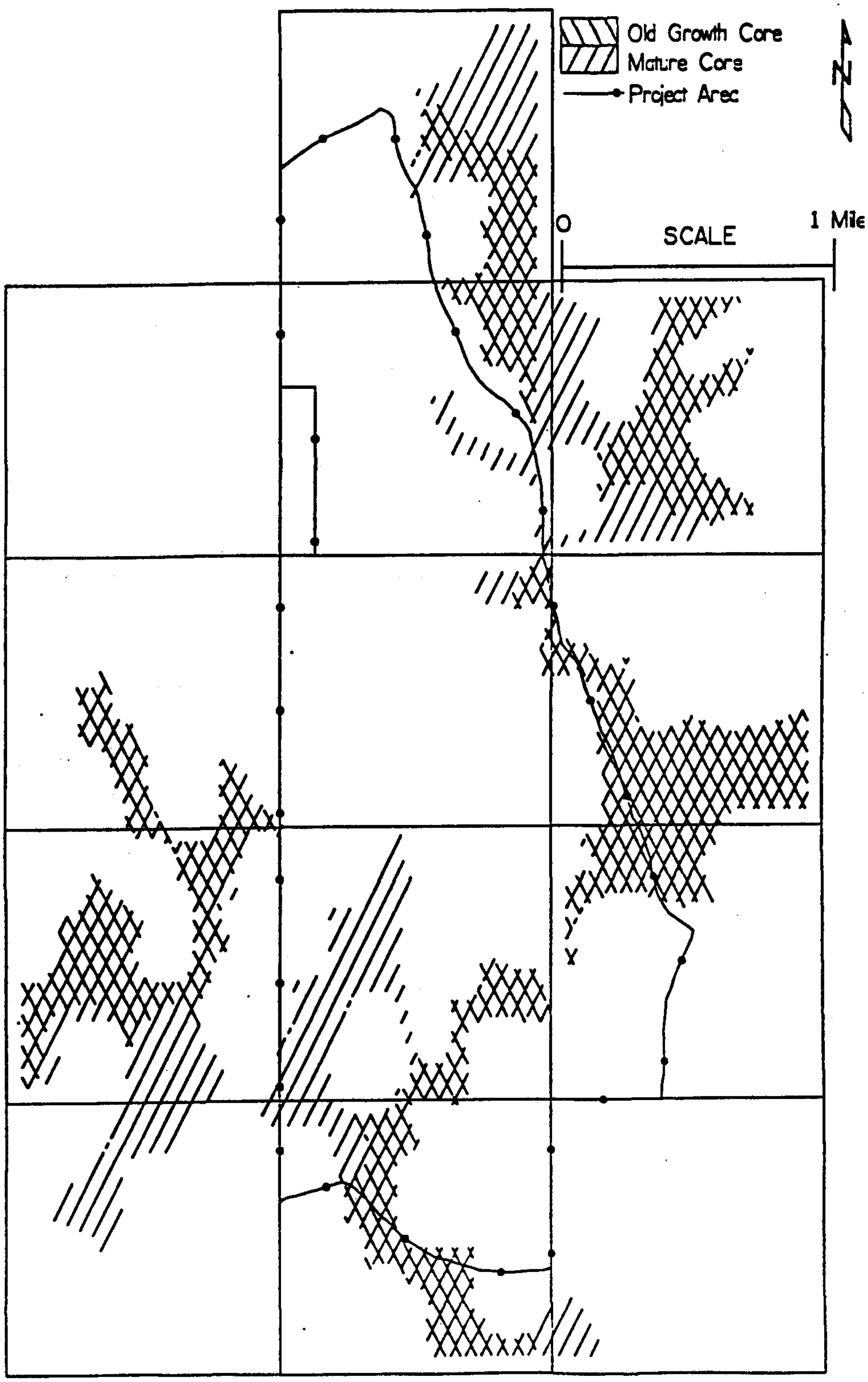
	------- Mature ----		------ Pole ------					
	Old Growth	Saw timber	Multi	Old	Young	Sapling	G/S/S	Nonforest
Old Growth		-0.07	-0.16	-0.21	-0.04	0.14	0.16	-0.02
Saw timber	-0.04		-0.03	0.00	-0.01	-0.00	0.03	0.07
Multi	0.05	- 0.02		0.33	0.01	-0.02	-0.02	0.12
Old Pole	-0.04	-0.00	0.15		0.00	-0.04	-0.05	-0.05
Young Pole	-0.02	-0.01	0.01	0 .01		0.04	-0.05	-0.02
Sapling	0.07	0.02	-0.01	-0.06	0.05		-0.05	-0.06
G/S/S	0.07	0.04	-0.00	-0.06	-0.02	-0.03		-0.04
Nonforest	0.02	0.04	0.05	-0.02	0.01	-0.02	-0.01	

c. Classified by merged tree-size classes. Here, adjacency with the same "class" is possible, because merged classes are composed of >1 tree-size classes.

	Mature	**Immature**	**Nonforest**
Mature	0.230	0.565	0.748
Immature	0.554	0.364	0.241
Nonforest	0.216	0.071	0.012
	1.0	1.0	1.0

Most stands within both the SRSF and ESAA are well-stocked (Table 3.7), and there appear to be no important distinctions between the ESAA and the larger SRSF. Similarly, stand structure characteristics within the ESAA display no obvious differences from the overall SRSF (Table 3.8). About an equal acreage of stands exist in single-storied and multi-storied conditions.

FIGURE 3.3



YEAR 0 NO ACTION ALTERNATIVE

Table 3.6 *Proportions of area in various forest types within the ESAA and SRSF.*

Forest Type	Proportion of Area	
	SRSF	ESAA
Douglas-fir	.168	.158
Larch	.176	.183
Douglas-fir - Larch	.173	.295
Lodgepole pine	.073	.016
Spruce	.119	.082
Subalpine fir	.073	.008
Cedar	.068	.005
Grand fir	.035	.035
Mixed conifer	.081	.083
Ponderosa pine	.018	.032
Western white-pine	.006	.020
White-bark pine	.004	.000
Noncommercial	.004	.000

Table 3.7 *Stocking levels on forested stands within the SRSF and ESAA.*

Stocking Level	Proportion of Area	
	SRSF	ESAA
Well	0.711	0.744
Moderate	0.150	0.117
Light	0.003	0.000
Poor	0.075	0.062
Nonstocked	0.032	0.056

Table 3.8 ***Stand structure on forested stands within the SRSF and ESAA.***

Structure	Proportion of Area	
	SRSF	ESAA
Primarily single-storied	0.439	0.410
Two distinct stores in stand	0.058	0.066
Three or more stories, or uneven-aged	0.430	0.440
Heterogeneous	0.011	0.006

5. Summary.

Given this assessment of the current state of the vegetative environment within the ESAA and the SRSF, primary concerns center not on the amount of mature and old-growth habitat per se, but rather on the degree of fragmentation as it relates to animal species which require large contiguous areas of mature and old-growth stands for population maintenance. Currently the largest stands of old growth and mature forests remaining within the SRSF are located within or adjacent to the proposed sale area. Most of these stands are relatively small in size. Of the 5 stands calculated to be larger than 200 acres (mean = 442 acres) significant portions of 2 lie within sale boundaries. The remaining 3 are isolated from one another. Existing fragmentation, particularly among stands within the sale area, has already greatly restricted available corridors between old growth and/or mature stands; additional harvesting may further exacerbate this situation. Edge effects which increase with increasing fragmentation may prove detrimental to many animal species.

II. EXISTING ENVIRONMENT RELEVANT TO OLD-GROWTH PRESERVATION

A. Analysis Area

The analysis of old growth is primarily based on the 2591-acre project area, but existing quantities of old growth are also considered in the context of SRSF and Soup and Cilly Creek watersheds. Data was obtained from the SRSF Stand Level Inventory.

B. Analysis Methods

The SRSF Stand Level Inventory identifies stands as old growth if they have a saw-timber stand class code, if the crown density of saw-timber trees in the stand is greater than 39 percent, if they contribute to a contiguous area of old growth at least 50 acres in size, and if they meet one of the following criteria:

1. The stand contains trees that average at least 200 years old.

2. The stand contains trees that average 150 to 199 years old, and it has an uneven-aged stand structure.

3. The stand contains trees that average 100 to 149 years old, and it has an uneven-aged stand structure and fair-to-poor or very poor vigor.

Vigor classes were used to project the relative stability of old-growth stands. The vigor of stands is directly related to the health of individual trees and the relative stability of stands. Stands having good-to-fair vigor or fair-to-poor vigor are likely to remain relatively stable for the next several decades. Some trees in old-growth stands having good-to-fair or fair-to-poor vigor would continue to die, maintaining the presence of snags and large down logs. Large trees of mixed species having varying degrees of shade tolerance would continue to dominate the stands.

Mortality is exceeding growth in stands having very poor vigor. Over the next several decades, stands having very poor vigor would continue to decline; trees would be killed by mountain pine beetle, Douglas-fir beetle, dwarf mistletoe, root rot, white pine blister rust, and other insects and diseases. Live, shade-intolerant trees would become scarce, and shade-tolerant species such as Engelmann spruce, grand fir, or subalpine fir would dominate the stands. Slow rates of natural decomposition would maintain an abundance of large snags and down logs for several decades, but species diversity and the abundance of large, live trees would decrease. Although the stands may be very old, old-growth characteristics that are important to many wildlife species would not exist or would become rare. Stands would move from an old-growth stage to a post-old-growth stage of succession.

C. Existing Environment

Old growth represents the later stages of natural development of forest stands. Old-growth stands are dominated by relatively large, old trees. They generally contain a wide variety of tree sizes; exhibit some degree of multistoried structure; have signs of decadence such as trees with rot, broken boles, or spiked tops; and contain standing, large snags and large down logs.

Approximately 36.4 percent of SRSF (14,506 acres) is old growth. About 50.5 percent (1309.2 acres, 9.3 percent of the total SRSF old growth) of the project area is classified as old growth. The old growth in the project area is located in 66 separate stands that range in size from 0.2 to 76.4 acres

About seventy-two percent of the existing old growth in the project area, or 934.6 acres, has good-to-fair or fair-to-poor vigor (Table 3.9, Figure 4.15); it will probably remain stable for the next several decades. About twenty-nine percent of the existing old growth, or 374.7 acres, has very poor vigor. The stands contained in the 374.7 acres would lose important old-growth characteristics over the next several decades.

III. EXISTING ENVIRONMENT RELATIVE TO TIMBER PRODUCTIVITY

A. Analysis Area

Timber productivity analyses are based on the 2,591-acre project area. Data used for assessing the existing vigor and timber productivity of the eight stand classes was obtained from the SRSF Stand Level Inventory.

B. Analysis Methods

The overall timber productivity of the project area is directly related to the vigor class of stands in the project area. The extent to which silvicultural treatments would affect the future timber productivity of stands depends on existing stand class and vigor. The average stand vigor of the No-Action Alternative provides a bases for comparing relative timber productivity with each action alternative. A vigor value of 1.00 represents a stand having full vigor and optimal timber productivity. A vigor value of 4.00 represents a stand having very poor vigor and negative timber productivity (mortality likely exceeds growth). The following vigor classes and their corresponding vigor values are based on the SRSF Stand Level Inventory.

1. Full vigor

The full vigor class has a vigor value of 1.00. It is represented by open-grown trees. Crown closure has not occurred, and growth is optimal.

2. Good-to-fair vigor

The good-to-fair vigor class has a vigor value of 2.00. Crowns are closed at least in clumps; crown lengths are greater than 50 percent in young stands and greater than 33 percent in older stands. Growth has not yet slowed greatly.

3. Fair-to-poor vigor

The fair-to-poor vigor class has a vigor value of 3.00. Crown ratios are poor. Growth and mortality are nearly balanced.

4. Very poor vigor

The very poor vigor class has a vigor value of 4.00. Stands having very poor vigor are generally in a decadent condition due to insects, disease, stagnation, suppression or old age. Mortality likely exceeds growth.

C. Past Management Activities

Timber harvesting has occurred periodically within the project area since the early 1960's. Past harvesting of old-growth and saw-timber classes have converted 38.6 percent of the project area to grass/shrub/seedling (4.0%), sapling (12.4%), young pole (15.1%) and multistoried classes (7.1%). These conversions have contributed to increases in vigor and timber productivity on the project area.

D. Existing Timber Productivity of Project Area

The Middle Soup Creek Project Area has a very high timber productivity potential because of its physical and biological characteristics. Old-growth stands in the project area exhibit lower timber productivity than young stands. The average vigor value of all old-growth stands in the project area is 3.01. Sapling stands have an average vigor value of 1.54, and young pole-timber stands average 1.76 (Table 3.9). Stands in the grass/shrub/seedling stand class are still in a stand establishment phase and will likely reach full vigor within five years. Residual overstory in multistoried stands is likely suppressing established regeneration and timber productivity. Multistoried stands have an average vigor value of 3.0. Saw-timber stands have an average vigor value of 2.24. The average vigor value of all stands in the project area is 2.50.

The existing vigor and timber productivity of the project area are summarized in Table 3.9 and Figure 3.4. Stands with full vigor represent 14.2 percent of the project area and occur on 367.1 acres. Stands with good-to-fair vigor represent 39.5 percent of the project area and occur on 1,024.1 acres. Stands with fair-to-poor vigor represent 28.1 percent of the project area and occur on 728.5 acres. Since nonforested areas (94.4 acres) do not contribute to timber productivity, they are also included in this zero-productivity vigor class. Stands with very poor vigor represent 18.2 percent of the project area and occur on 471.3 acres.

E. Existing Timber Productivity of Stands Considered for Harvest

The SRSF Stand Level Inventory identifies 19 stands for possible timber harvesting. These stands represent 58.6 percent of the project area and contain 1,517.8 acres. Stands identified for possible timber harvesting include stands with the treatment codes high risk, low risk, and overstory removal. The high-risk category includes commercial, nonvigorous, over mature stands and any merchantable stands which exhibit unmanageable insect or disease problems. The low-risk category includes commercial stands older than 100 years which do not qualify

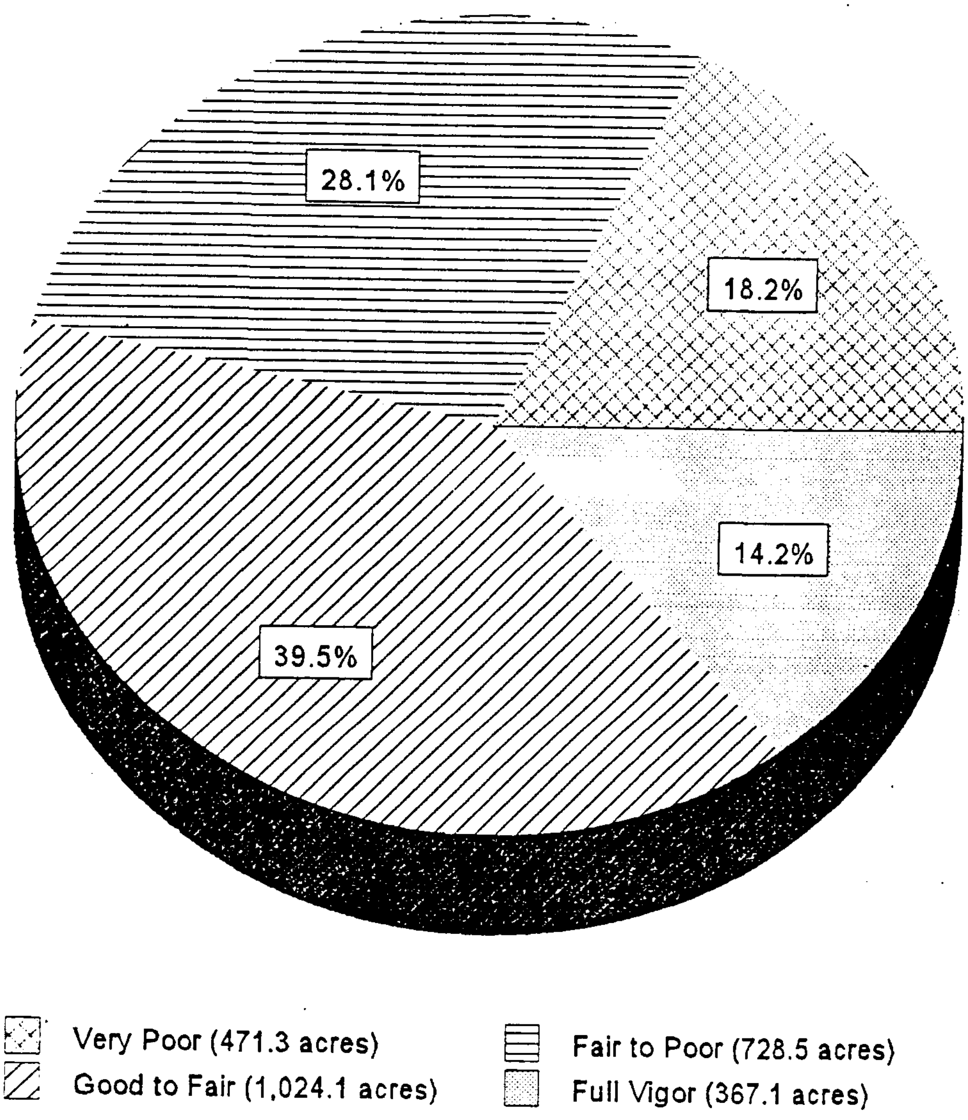
Table 3.9 The Vigor and Productivity of Existing Stand Classes

Stand Class	Vigor Class	Vigor Value	Acres	% of Project Area	*Average Vigor Value
Old Growth	good to fair	2.00	357.9	13.8%	
	fair to poor	3.00	576.7	22.3%	
	very poor	4.00	374.7	14.5%	
subtotal			1,309.2	50.5%	3.01
Saw Timber	good to fair	2.00	137.7	5.3%	
	fair to poor	3.00	44.5	1.7%	
subtotal			182.3	7.0%	2.24
Multistoried	full	1.00	21.1	0.8%	
	good to fair	2.00	53.9	2.1%	
	fair to poor	3.00	12.9	0.5%	
	very poor	4.00	96.6	3.7%	
subtotal			184.6	7.1%	3.00
Old Pole Timber	good to fair	2.00	4.4	0.2%	2.00
Young Pole timber	full vigor	1.00	93.9	3.6%	
	good to fair	2.00	296.6	11.4%	
subtotal			390.5	15.1%	1.76
Sapling	full vigor	1.00	147.2	5.7%	
	good to fair	2.00	173.6	6.7%	
subtotal			320.7	12.4%	1.54
Grss/Sdlng/Shrb	full vigor	1.00	104.9	4.0%	1.00
Nonforested	N/A	N/A	94.4	3.6%	3.00
subtotal			199.3	7.6%	3.00
TOTAL			2,591.0	100%	2.50

<u>*Vigor Classes*</u>	<u>*Timber Productivity*</u>	<u>*Vigor Value*</u>
Full:	*positive productivity, near yield potential*	*1.00*
Good to Fair:	*positive productivity, growth exceeds mortality but falls short of yield potential*	*2.00*
Fair to Poor:	*zero productivity, mortality balances with growth*	*3.00*
Very Poor:	*negative productivity, mortality exceeds growth*	*4.00*
N/A:	*nonforested*	*3.00*

* Average weighted by area.

Figure 3. 4 ***The Existing Vigor of Stands in the Project Area: A Measure of Timber Productivity***



The *percentages are based on 2,591 acres within the project area. The average vigor value for all the stands in the project area is 2.50. Vigor values and classes are as follows:*

vigor value	*vigor class*	*timber productivity*
4.00	*very poor:*	*negative productivity, mortality exceeds growth.*
3.00	*fair to poor:*	*zero productivity, mortality balances with growth.*
2.00	*good to fair:*	*positive productivity, growth exceeds mortality but falls far short of yield potential.*
1.00	*full vigor:*	*positive productivity, near yield potential.*

as high risk. These stands have relatively better vigor than high-risk stands. The low-risk category also includes stands dominated by shade-tolerant species regardless of age. The overstory removal category includes stands which contain commercial size trees in excess of 1,000 board feet per acre if the trees are (1) part of an unmanageable stand component, or (2) the trees represent the upper story of a two-storied stand but are inadequately stocked to be treated as a separate, manageable component. Table 3.10 gives the acres considered for treatment within each treatment code, the average volume of timber per acre, and the total volume within each treatment code.

TABLE 3.10 ***A Summary of Stands Considered for Harvest***

Treatment Code	Acres	Average Volume Per Acre (MBF)	Total Volume (MMBF)
high risk	939	26	24.4
low risk	495	20	9.7
overstory removal	83	6	0.5
TOTAL	1517	N/A	34.6

IV. OTHER RESOURCE CONCERNS

A. Grizzly Bear

1. Analysis area

The grizzly bear is federally listed as threatened in Montana. The Middle Soup Creek Project Area is within the Northern Continental Divide Ecosystem Grizzly Bear Recovery Area (NCDE) (US Fish and Wildlife Service 1993). The NCDE is divided into 23 Bear Management Units (BMU's); each BMU is further divided into subunits approximately 50 square miles in area. Subunits define the area in which the existing environment and effects of proposed actions on grizzly bears are evaluated (US Fish and Wildlife Service 1995a). The project area is within the South Fork Lost Soup Subunit of the Bunker Creek BMU.

The South Fork Lost Soup Subunit encompasses 29,923 acres (46.8 mi^2). DNRC administers 62 percent (18,446 acres) of the subunit, the Flathead National Forest administers 36 percent, and Plum Creek Timber Company owns approximately one percent. The remaining one percent of the subunit is in other private ownership (Table 3.11).

2. Analysis methods and environmental characteristics
Attributes of the subunit used to describe the existing environment include motorized access, security habitat, hiding cover, and seasonal habitats. Guidelines for analyses follow DNRC Interim Guidance for grizzly bears in the NCDE (Montana Dept. of Natural Resources and Conservation 1995) and Amendment 19 to the Flathead National Forest Plan (USDA Forest Service 1995).

a. motorized access
Motorized access has been shown to be an important factor affecting grizzly bears (Mace et al. 1993). Increased motorized access results in increased human-caused bear mortality, displacement of bears from energetically important habitats, and habituation of bears which often leads to bears being killed or removed to captivity (Interagency Grizzly Bear Committee 1994).

Motorized access routes in the project area include roads classified as open, restricted, reclaimed, private, administrative, and Highway 83. Definitions for all classes of roads are located in the glossary under roads. Motorized access in the subunit is calculated by two methods: the linear miles of the various road classes and the "precise density" of roads using a "moving windows" method (Ake 1995).

In the moving windows analysis, the South Fork Lost Soup Subunit is divided into 30-meter square "windows." Open road density (ORD) is calculated as the percentage of windows in the subunit with more than one square mile of open road around them. Total road density (TRD) is the percentage of windows in the subunit surrounded by more than two square miles of open and restricted roads.

Within the South Fork Lost Soup Subunit, there are 29.8 miles of open road, 52.2 miles of restricted road, and 19.9 miles of other roads (Table 3.11). The ORD of the entire subunit is thirty-four percent. For DNRC land within the subunit, the ORD is forty-three percent. For the entire subunit TRD is forty-three percent; DNRC land in the subunit has a TRD of fifty-two percent.

Table 3.11 ***South Fork Lost Soup Subunit Attributes and Ownerships***

Subunit Attributes	DNRC	FNF	Plum Creek	Small Private	Total
Ownership acres (% of subunit)	18,446 (62%)	10,895 (36%)	147 (1%)	435 (1%)	29,923 (100%)
Hiding cover acres (% of ownership)	16,891 (92%)	6,881 (63%)	unknown	unknown	≥23,772 (≥79%)
Security habitat acres (core area)	5,074	6,241	0.0	0.0	11,315
Open Roads[1,2,3] miles	22.3	7.5	0.0	N/A	29.8
Restricted, non-core roads[1,2,3] (miles)	38.6	8.9	1.0	N/A	48.5
Restricted, core roads[2] (miles)	2.6	1.1	0.0	N/A	
Reclaimed roads (miles)	9.6	2.9	0.5	N/A	13.0
Private roads[3] (miles)	N/A	N/A	N/A	0.7	0.7
Administrative and county roads[3] (miles)	1.3	0.0	0.0	N/A	1.3
Highway 83[3] (miles)	3.0	1.4	0.0	0.5	4.9
Precise Open Road Density >1.0 mi/sq mi	43%				34%
Precise Total Road Density >2.0 mi/sq mi	52%				43%

[1] included in calculation of precise open road density
[2] included in calculation of precise total road density
[3] included in calculation of core area

b. security habitat
Security habitat or core area (habitat free of motorized access) is an important home-range component of female grizzly bears that successfully raise cubs to adulthood (US Fish and Wildlife Service 1995a). Security habitat is at least 0.3 miles from a motorized road or trail during the nondenning period (3/16-11/15) and a minimum of 2500 contiguous acres. Thirty-eight percent (11,315 acres) of the South Fork Lost Soup Subunit qualifies as security habitat of which DNRC administers 5,074 acres.

c. hiding cover
Hiding cover is defined as a patch of vegetation having a minimum diameter of at least three sight distances or 300 feet--whichever is greater. A sight distance is the distance at which 90 percent of a bear is hidden from view. Approximately 79 percent of the South Fork Lost Soup Subunit qualifies as hiding cover; 92 percent of DNRC land within the subunit meets hiding cover criteria.

d. seasonal habitat
Research in the lower South Fork of the Flathead statistically compared habitats used by grizzly bears with available habitats in the study area for five seasons (Manley et al. 1992): early spring (March 16 - May 7), spring (May 8 - July 15), summer (July 16 - September 30), autumn (October 1 - November 15), and denning (November 16 - March 15). Habitats were described using a combination of satellite imagery and topographic data.

For each season, habitats in the study area were placed into one of three probability categories: use less than, equal to, or greater than expected by grizzly bears. These categories are assumed to reflect the relative seasonal value of habitats to grizzly bears. Habitats used greater than expected are of the highest value to grizzly bears.

Since habitats were described using remote sensing technology, habitat values outside of the South Fork study area can be described. This has been done for the NCDE west of the Continental Divide (USDA Forest Service 1995). Table 3.12 summarizes existing grizzly bear habitat values in the South Fork Lost Soup Subunit and security habitat within the subunit. Representative proportions of all five seasonal habitats are found within security areas in the subunit.

Table 3.12 ***Acres of Grizzly Bear Seasonal Habitats throughout the South Fork Lost Soup Subunit and Core Areas within the Subunit (Manley 1992)***

Early Spring[1] (3/16 - 5/7)	Entire Subunit	Security Areas
use < expected	4,484 (26%)	188 (13%)
use = expected	9,391 (54%)	916 (61%)
use > expected	3,462 (20%)	385 (26%)
Spring (5/8 - 7/15)	**Entire Subunit**	**Security Areas**
use < expected	13,531 (45%)	3,259 (26%)
use = expected	9,104 (31%)	4,507 (36%)
use > expected	7,288 (24%)	4,732 (38%)
Summer (7/16 - 9/30)	**Entire Subunit**	**Security Areas**
use < expected	14,408 (48%)	3,699 (30%)
use = expected	6,256 (21%)	2,583 (21%)
use > expected	9,259 (31%)	6,216 (49%)
Autumn (10/1 - 11/15)	**Entire Subunit**	**Security Areas**
use < expected	11,014 (37%)	2,753 (22%)
use = expected	8,949 (30%)	3,488 (28%)
use > expected	9,960 (33%)	6,256 (50%)
Denning (11/16 - 3/15)	**Entire Subunit**	**Security Areas**
use < expected	13,065 (44%)	3,196 (25%)
use = expected	14,289 (48%)	6,963 (56%)
use > expected	2,568 (8%)	2,338 (19%)

[1] below 5,000 feet elevation

B. Elk

The project area is used by elk from early spring through late fall. The conifer and mixed conifer/deciduous stands provide a variety of successional stages and forest types that are used for thermal cover, hiding cover, resting, and foraging.

1. Analysis area

The analysis area is about 5843 acres and contains the project area and a 0.5 mile buffer (Figure 3.5). Areas of private ownership were excluded from analysis because data on hiding and thermal cover and forage were not available. For parts of the analysis, the area was divided into four quadrants of roughly equal size (Figure 3.5).

2. Analysis methods

A method for determining the adequacy of an area as potential elk habitat was developed by the Flathead National Forest and the Montana Department of Fish, Wildlife and Parks (MFWP), based on work conducted in northern Idaho (Leege 1984). This analysis procedure deals with general habitat considerations and not with site specific features such as moist sites and calving areas. This method was applied to the project area using the SRSF Stand Level Inventory and GIS map layers developed for the SRSF. The criteria used to calculate elk habitat potential are road density and human use, size and distribution of hiding and thermal cover, size and distribution of forage areas, and adequacy of security areas. Elk habitat potential is estimated based on the difference between optimal and actual conditions (the "reduction" from optimal conditions). Calculations are located in Project File # 605.

3. Existing environment

a. open roads

Open roads were estimated to receive over 20 vehicle trips per week. The analysis area is 9.2 square miles and has 11 miles of open road; open road density is 1.2 miles per square mile. The analysis assumes that elk avoid areas with roads that are heavily used by humans and considers these areas unavailable as potential elk habitat. Due to road effects, 55 percent of the project area remains available as potential elk habitat.

b. size and distribution of hiding and thermal cover

Summer thermal cover is provided on 61.2 percent of the analysis area and hiding cover is provided on 90.9 percent of the analysis area. Cover is well distributed, being present in each quadrant of the analysis area. Cover is more than adequate and elk habitat potential is not reduced due to insufficient hiding or thermal cover.

FIGURE 3.5 ELK AND WHITE-TAILED DEER ANALYSIS AREA

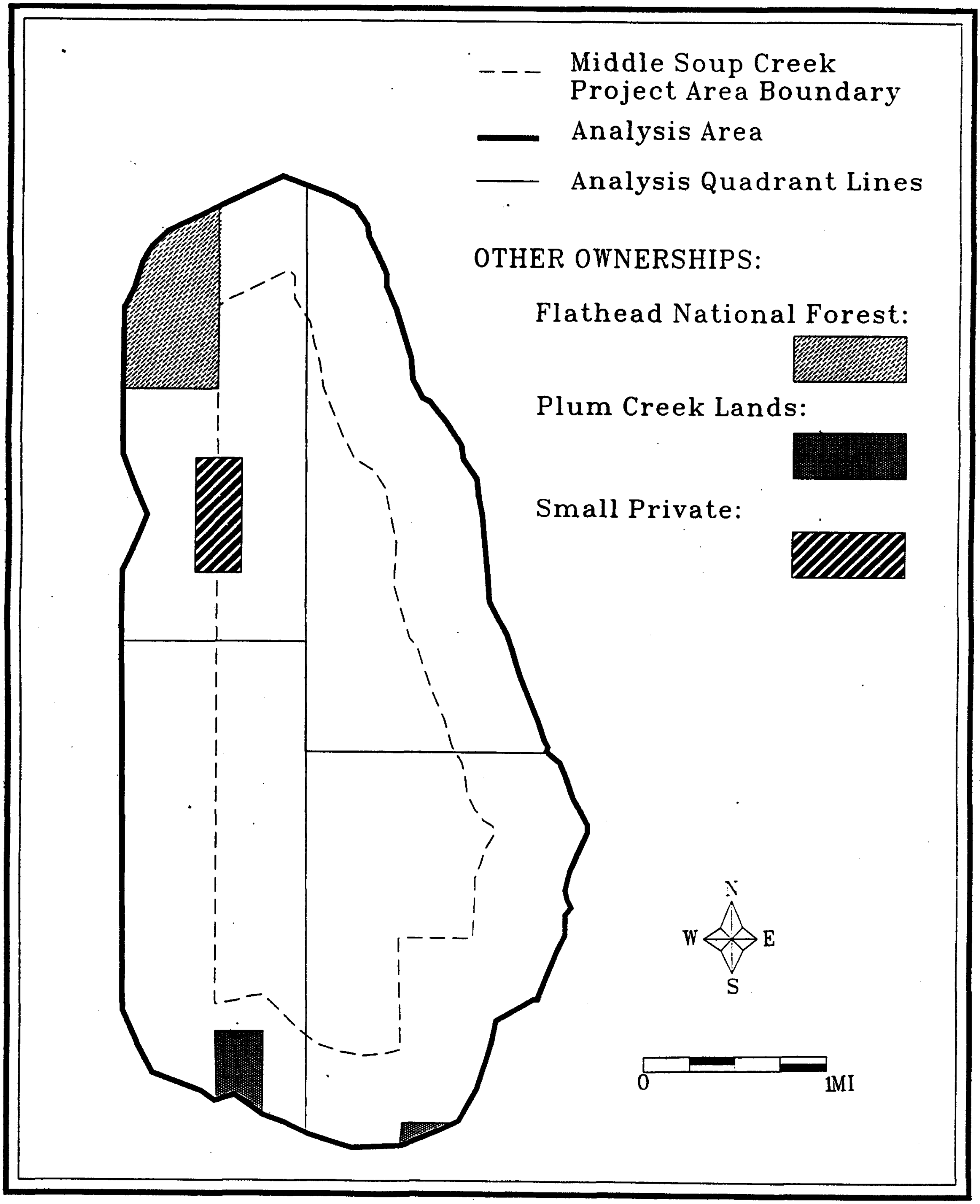


Figure 3.5

c. size and distribution of forage areas
Forage is present in all four quadrants and 99 percent of the forage areas are within 500 feet of cover. The value of potential elk habitat was reduced, however, because only 26.2 percent of the analysis area provides forage (≥30% is optimal), and because there is less than 800 feet of cover between most of the openings (optimal conditions are ≥800 feet of cover between ≥75% of the openings). Potential elk habitat is thus reduced by 10 percent.

d. adequacy of security area
Security areas are defined as areas more than 0.5 miles from an open road and larger than 250 contiguous acres in size. Twenty-six percent of the analysis area provides security, and 78 percent of the land in security areas provides cover. This is adequate and elk habitat is not reduced due to insufficient quantity or quality of security areas.

e. summary
Overall elk habitat potential is 50% due to open road density and inadequate forage areas.

C. White-Tailed Deer

The project area is used by white-tailed deer from early spring through late fall during climatically normal years. The conifer and mixed conifer/deciduous stands provide a variety of successional stages and forest types that are used for thermal cover, hiding cover, resting, and foraging.

1. Analysis area

The analysis area used for white-tailed deer is the same as the analysis area for elk (Figure 3.5).

2. Analysis methods

Analysis methods used for white-tailed deer consist of comparing the existing environment to desired conditions that have been recommended by MFWP biologists.

3. Existing environment

White-tailed deer summer range habitat recommendations are as follows (Cross 1983): at least 50 percent of upland habitat should provide thermal cover, at least 75 percent should provide hiding cover, and about 25 percent should provide foraging areas. These recommendations are all being met: thermal cover is provided on 61.2 percent of the area, hiding cover is provided on 90.9 percent of the area, and forage is provided on 26.2 percent of the area.

Riparian areas are important components of white-tailed deer summer range and the following additional recommendations pertain to these areas (Cross 1983): multispecies, multistoried stands should be maintained adjacent to riparian areas, and these stands should be at least 1.5 sight distances or 100 feet wide, whichever is greater, if unmanaged, and at least 300 feet wide if managed.

Timing of activities could affect white-tailed deer. Logging in the fall and early winter would result in an abundance of lichen on the ground. Lichen is a preferred forage, and deer using the area as fall-transition range and as a migration route to winter range may stay in the area longer than usual to feed on the lichens. In the event of a heavy snow-fall, deer may be essentially trapped in the area, which may result in high mortality. Logging after deer have moved to winter ranges would avoid this.

D. Gray Wolves

1. Analysis area and methods

The analysis area and method of estimating open road density for wolves are the same as the analysis area and methods for elk and white-tailed deer (project area plus a 0.5-mile buffer) (Figure 3.5).

2. Environmental characteristics

The project area is within the Northwest Montana Wolf Recovery Area (US Fish and Wildlife Service 1987) where wolves are federally listed as an endangered species. Wolves are not known to currently inhabit the Swan Valley.

The primary factors in managing habitat for wolves include (1) maintaining an adequate prey base, and (2) preventing illegal, human-caused mortality.

The most abundant prey species in the project area are white-tailed deer and elk, preferred prey species of wolves in northwest Montana (Boyd et al.1994). Moose also use the area. The area is primarily spring - fall range, although ungulates may remain in the area during winters with below-average snow accumulation. Ungulate calving/fawning sites may be scattered throughout the project area, but no specific sites have been identified. White-tailed deer and elk are addressed separately in this document.

Persistence of disjunct wolf populations have been related to open road densities, proximity to larger populations of wolves (a source of dispersers to offset wolf mortality), and human attitudes.

In Wisconsin (Theil 1985) and Minnesota (Mech 1988), disjunct wolf populations distant from a larger source population did not persist in areas with more than 0.9 miles per square mile. This threshold road density may vary with topography, road use, human attitudes, and other factors. Using the same analysis area for white-tailed deer and elk (the project area plus a 0.5-mile buffer), the open road density is 1.2 miles per square mile.

E. Sensitive Species

Several approaches can be taken to assess impacts to wildlife species that are dependent on old growth and/or that are particularly sensitive or vulnerable to human disturbance; each approach has its strengths and weaknesses. Two broad categories of approach to analysis are the coarse filter and fine filter. Fine filter refers to addressing individual elements in an ecosystem--in this case impacts to individual species of wildlife. Coarse filter refers to addressing the integrity of the ecosystem as a whole. The interdisciplinary team has chosen to analyze impacts to wildlife using primarily the coarse-filter approach. The coarse-filter approach is based on the premise that by maintaining the integrity of ecological systems, habitat for wildlife species that have evolved in these systems will be maintained. This approach can be more effective than the fine-filter approach given the reality of limited resources available for analysis. Analyzing for ecological integrity requires a multifaceted approach. For the analysis of effects of the project on wildlife, these analysis components include the total amount of forest in different successional stages, forest patch size and shape, juxtaposition of forest patches of different successional stages, and connectivity between patches or fragmentation.

The coarse-filter approach was also chosen because it avoids some of the problems inherent in the fine-filter approach. The individual species approach is limited by the lack of information available on the many processes and interactions that must occur to assure viability of a species. For many species, knowledge is limited or lacking on distribution, abundance, and essential abiotic habitat components. Almost nothing may be known about habitat components needed to support essential prey species, community dynamics, or how human alteration of the habitat may affect species and communities. Compounding these limitations is the sheer number of wildlife species existing in a general area and the different habitat requirements of each one.

A recognized limitation of the coarse-filter approach is that some elements will fall outside its purview. In the case of the Middle Soup Creek Project analysis for effects to wildlife, these include wildlife species that occur at low densities and are under threat of over exploitation or are negatively affected by factors in addition to the manipulation of vegetation (We assume that the analysis for ecosystem sustainability will address impacts associated with the manipulation of vegetation). For these reasons, we decided to supplement the coarse-filter analysis with a fine-filter analysis for species that have been identified as sensitive by the adjacent Flathead National Forest (FNF). Sensitive species are species for which there is concern for long-term population viability, that are vulnerable to human actions, and that may become listed under the federal Endangered Species Act without proactive management. Impacts to all nine FNF sensitive species were assessed; four of these species were dismissed in Chapter I, and the remaining five species are discussed below.

1. Western big eared bat

Roosting, feeding, and breeding occur in caves, mine shafts, rock outcrops, lava tubes, and occasionally buildings. Tree cavities are occasionally used for daytime roosting. This species is probably limited by the number of suitable roosting sites surrounded by adequate foraging habitat. Although not confirmed, the presence of western big-eared bats is suspected in the Swan Valley (Reichel 1995).

There are no caves within the project area. Rock cliffs, located one or two miles from the project area (see "American Peregrine Falcon," Chapter I), may provide roost sites. Some of the larger hollow trees may also provide roost sites.

2. Fisher

Fishers primarily use riparian areas and mature to old-growth grand fir, subalpine fir, cedar, and hemlock forests, at elevations below 6300 feet. Older forests likely have higher densities of accessible prey as well as resting and natal den sites. High densities of downed logs, large overstory trees, and a relatively closed canopy are important habitat components.

Fishers were extirpated from the Northern Rockies by about 1930. Some fishers now exist in northern Idaho and the west slopes of the Rockies due to reintroduction efforts, but population numbers are very low (Heinemeyer 1994). Most of the project area has been identified as potential fisher habitat (USDA Forest Service 1994b).

3. Lynx

Lynx are associated with boreal and montane forests. They require early successional forest that contains high numbers of prey for hunting, mature forest for denning and cover for kittens, and densely forested cover for travel and security. Predicted denning habitat in the Swan Valley is at higher elevations corresponding with the range of spruce and fir-dominated cover types (USDA Forest Service 1994b). In the vicinity of the project area this would be at an elevation of about 5,000 feet and above. This is higher than the highest elevation within the project area, about 3700 feet, and lynx are consequently not expected to den within the project area.

Lynx are highly dependent on snowshoe hares for prey. Good snowshoe hare habitat is coniferous forest with over 4500 stems per acre. Predicted potential feeding habitat extends across the Swan Valley floor (USDA Forest Service 1994b). About 30 sets of adult lynx tracks have been observed by one individual in the Soup Creek Watershed in the past 30 years, confirming that this area is used by lynx for feeding and travel (Gray 1995).

4. Black-backed woodpecker
The black-backed woodpecker requires areas with high concentrations of recently dead trees and logs for feeding. Feeding trees have usually been dead less than two to three years and harbor high concentrations of wood-boring insects, particularly larvae and pupae of bark beetles. Recently burned areas are heavily used, but patches of unburned insect-infested trees are also used. Nesting is usually in dense patches of green trees, and nest trees are at least 17 inches dbh and have heartrot.

Suitable nest trees exist within the project area. Although no fires have occurred in or near the project area in the recent past, scattered throughout the project area are many pockets of Douglas-fir that are heavily infected with bark beetles that should provide adequate, though not optimal, feeding habitat.

5. Bog lemming
Bog lemmings are associated with sphagnum bogs or hummocky meadows dominated by sedges, often containing standing water. Bog lemmings have been seen on the Kootenai and Flathead National Forests, and in Glacier National Park. Suitable bog lemming habitat may exist within the project area.

F. Cavity-Dependent Wildlife
Many species of birds and mammals are totally or largely dependant on dead trees (snags) and defective trees (partially dead, spike top, broken top) for nesting, denning, roosting, feeding, and cover. Snags and defective live trees may be the most valuable individual components of Northern Rocky Mountain Forests for wildlife species (Heijl 1991). The quantity, quality, and distribution of snags affect presence and population size of many cavity-dependent species. Twenty-one species of birds and two species of mammals are recognized as totally or largely dependent on cavity habitat on the adjacent Flathead National Forest. The following tree species are highly to moderately preferred by cavity nesters: western larch, paper birch (*Betula papyrifera*), ponderosa pine, cottonwood, aspen, and subalpine fir McClelland 1977, Thomas 1979). Most of the Middle Soup Creek Project Area is low-elevation with gentle terrain, and western larch is a dominant tree species in many of the stands. These conditions are of very high value to many species of cavity-dependent wildlife.

Previous salvage harvest in the Soup Creek and Cilly Creek watersheds removed about 0.125 dead and dying trees per acre annually during the 70's and 80's. Using the maximum harvest estimates, a total of about 2.5 dead trees per acre were harvested, although large spatial variation exists. Salvage harvest has not been conducted in the past five years.

To obtain a rough estimate of the existing density of snags and snag recruits in the project area, and to address concerns that previous salvage harvests may have reduced snag densities to low levels, eight transects were run throughout the project area. Larger contiguous polygons of forest were chosen for transect locations. It was noted that salvage harvesting had been done to various degrees at all locations sampled. All snags at least 10 inches in dbh and overstory trees at least 21 inches dbh were counted along transects that were 660 feet long (3 220-foot segments) and 66 feet wide, for a total coverage of one acre on each transect.

Table 3.13 *Snags and Overstory Trees on Sample Transects*

Species	average number of overstory trees/acre		average number of snags/acre		
	21 - 30" DBH	≥30" DBH	10-12" DBH	13-20" DBH	≥21" DBH
western red cedar	0.50	0.50	-	-	-
cottonwood	-	-	-	-	0.12
Douglas-fir	2.75	-	0.12	0.75	0.50
Engelmann spruce	0.12	-	0.12	0.12	-
subalpine/grand fir	0.50	-	1.12	1.00	0.12
western larch	8.25	1.87	0.37	0.62	1.12
western white pine	0.50	-	2.00	1.00	0.12
Total	12.75	2.37	3.75	3.50	2.00

Although these transect data give only a rough estimate of snag and snag recruit density, they indicate that there are adequate numbers of snags and large diameter snag recruits to support healthy populations of cavity-nesting birds (Thomas 1979). Decay and decadence is presently increasing in the area due to high, patchy activity of several insects and diseases including the Douglas-fir bark beetle, mountain pine beetle, and the heartrot fungus (*Phellinus pini*). These processes are creating additional larch snags which provide good cavity habitat, and Douglas-fir and western white pine snags which provide good feeding and some cavity habitat.

Some species that use standing snags also require downed wood. Pileated woodpeckers and pine marten, for example, are two species that require both large diameter snags and relatively high densities of downed logs. Pileated woodpeckers are highly dependant on carpenter ants, and find them on the bark and outer surfaces of snags, logs and stumps. Feeding sites are a critical and sometimes limiting habitat component. Marten use large downed logs and stumps for resting and denning sites. Marten also require logs and stumps that project out from the snow to provide access to subnivean spaces when searching for small mammal prey. Because salvage harvesting removes downed wood recruits, data was gathered to estimate existing downed wood densities in the project area.

Eight transects were run in the same area as the snag and overstory tree transects. Pieces of downed woody material that transected a 400-foot straight line (2 200-foot segments) were counted by size class, and tons of downed woody material per acre were estimated by size class. Only whole, relatively sound logs (corresponding to log decay classes 1 to 3) (Maser 1979) at least six inches dbh were counted. This gives a conservative estimate of the total amount of downed wood available. Data from these transects yield an estimate of 10.48 tons per acre of sound wood at least six inches in dbh (range 6.5-13.2 tons/acre), and 8.11 tons per acre of sound downed wood at least eleven inches dbh (range 5.2-12.3 tons/acre).

The amount of woody debris naturally present in mature forests varies greatly, depending on the occurrence of natural and catastrophic events, decomposition rates, and forest type, and precludes predicting the amount that is "normal" for a forest (Hayward 1994, Montana Dept. of Natural Resources and Conservation 1978a). The minimum amount of coarse woody debris necessary to meet habitat requirements of all old-growth associated species is not known. Some estimates have been made on downed wood requirements for some species: at least 40 logs per acre greater than 15 inches dbh for pileated woodpeckers and associated species (Bull 1994); and 15 tons per acre should be adequate for marten habitat (Buskirk 1995). The Middle Soup Creek Project Area has substantially less than the recommendation for pileated woodpeckers, and appears to be marginal for marten, although these species do inhabit the project area.

G. Water Quality

1. Hydrology

Soup and Cilly creeks are perennial streams that flow westerly from the Swan Range to the Swan River. The Soup Creek watershed contains 15.9 square miles of area. The Cilly Creek watershed contains 8.6 square miles. Stream gradients in the upper portions of both watersheds are steep, but stream gradients in the lower portion of the watersheds, within the project area, are more gentle.

Cilly Creek has less seasonal fluctuation in streamflow than Soup Creek; the high-elevation headwaters of Soup Creek receive more snowmelt than Cilly Creek. Soup Creek has high streamflow during snowmelt and relatively low base flow. The average annual precipitation in the project area is 30 inches. Along the crest of the Swan Range, near the headwaters of both creeks, the average annual precipitation is 70 inches.

2. Water quality standard
The Swan River Drainage, including Soup and Cilly creeks, is classified as a B-1 drainage (Administrative Rules of Montana, Title 16). The following restrictions apply to B-1 waters: the maximum allowable increase above naturally occurring turbidity is five NTU's (nephelometric turbidity units), and only a one degree maximum increase above naturally occurring water temperature is allowed.

3. Runoff and sediment monitoring data
The water quality of Soup Creek was monitored near the Soup Creek Campground for five years between 1976 and 1983. Streamflow ranged from 2 to 88 cubic feet per second (cfs). The average flow was five cfs. The highest total suspended solids (TSS) concentration on the forest was 102 milligrams per liter. The average TSS concentration was eight milligrams per liter; eighty-five percent of the measurements were less than 10 milligrams per liter. Average annual TSS yield was 22 tons of sediment per square mile.

The water quality of Cilly Creek was monitored near the creek's crossing of Highway 83 in 1976. Cilly Creek's discharge per unit area was low relative to other monitored SRSF streams at high flow. At low flow, it was similar to the discharge at other low-elevation creeks (Goat, Soup, and Squeezer creeks) on the east side of the valley. TSS concentration ranged from 0.3 to 25.4 milligrams per liter. In 1991, Cilly Creek was monitored in three locations. Thirty-eight samples were taken. TSS concentration ranged from 0.1 milligram per liter to 6.8 milligrams per liter. Discharge ranged from 0.2 cfs to 62 cfs.

4. WATSED analysis
The WATSED model measures changes in water and sediment yields due to timber harvesting (USDA Forest Service 1991). Water yield and sediment yield values should not be considered as absolute quantities; rather, they should be used to compare the relative differences between the effects of activities. WATSED summaries are located in project file 603.

a. water yield
Water yield is a term used to describe the amount of average annual runoff for a particular watershed and is measured in acre-feet. Water yield increase is an estimate of the percent increase in average annual runoff over "natural," modeled conditions due to forest canopy removal. The following factors help determine or measure water

yield increases: percent of forest canopy removed, timber harvesting methods, number of acres harvested, rate of ground saturation, and amount of snowpack.

"Equivalent clearcut area," or ECA, is the total area within a watershed that exists in a clearcut condition, including clearcuts, partial cuts, roads, and burns. ECA is a function of the amount of canopy removed and the size of the area harvested. Existing ECA is used to describe the number of acres that have been previously harvested and the degree of hydrologic recovery that has occurred due to revegetation. Remaining ECA is the calculated amount of harvest that may occur without substantially increasing the risk of causing detrimental effects to stream channel stability.

A water yield analysis was completed for Soup and Cilly creeks using the WATSED model. Table 3.14 gives the number of acres that have been harvested and the miles of road that have been built in the Soup Creek and Cilly Creek watersheds since the 1960's. The allowable increase in water yield, based on channel stability, is ten percent for both drainages (Haupt 1976). Table 3.15 shows the results. Neither Soup Creek nor Cilly Creek has a water yield that exceeds the allowable increase over natural, modeled conditions. Up to 726 equivalent clearcut acres could be harvested in Cilly Creek Watershed before the allowable water yield increase is exceeded, and up to 2,133 equivalent clearcut acres could be harvested in Soup Creek Watershed before Soup Creek would exceed its allowable increase (Table 3.15).

Table 3.14 ***Past Timber Harvesting in Soup Creek and Cilly Creek Watersheds***

Acres or Miles	Cilly Creek Watershed	Soup Creek Watershed
Total Watershed Size (acres)	5,059	9,799
Acres Harvested (percent)	889 (18)	1,353 (14)
Roads Built (miles)	27	26

Table 3.15 ***Water Yield of Soup Creek and Cilly Creek Watersheds***

Water Yield	Cilly Creek Watershed	Soup Creek Watershed
Average Annual Runoff (acre-feet)	6,901	19,831
Existing ECA (1996)	474	567
Percent Water Yield Increase	3	1
Allowable ECA	1,200	2,700
Remaining ECA	726	2,133

b. sediment yield

Sediment yield is the amount of sediment that is carried to streams. The following factors help determine or measure sediment yield: area of cutting units, area of roads, slope steepness, erosivity, and logging methods. Sediment yield analysis is best suited to evaluating alternatives that include different amounts and locations of cutting units, roads, and varying levels of sediment mitigation to roads and structures.

The WATSED analysis shows that Soup Creek Watershed is currently at 18 percent over "natural," modeled sediment yield, and Cilly Creek is 44 percent over natural conditions; however, results indicate that neither Soup Creek nor Cilly Creek are accumulating or storing generated sediment. The WATSED model can estimate the amount of sediment that is stored in deposition and not routed through the creek. The model does not account for point sources of sediment, so they are not reflected in the modeled sediment results.

5. Sediment source sites

Several human-made structures in the Soup Creek and Cilly Creek watersheds are existing sediment sources. Two large culverts on perennial tributary streams are not functioning properly and three log sill bridges have failing abutments and are currently producing sediment. The upper reaches of Soup Creek Canyon Road have inadequate surface drainage and erosion control. Two log sill bridges on secondary roads crossing Soup Creek have collapsed and are contributing sediment to the channel.

With the exception of the situations mentioned above, the drainage conditions on DNRC-held portions of Soup Creek and Cilly Creek roads is adequate and meet BMP guidelines (Logan 1991).

H. Fisheries

Westslope cutthroat trout and bull trout are species of special concern in Montana; they are found in limited numbers and habitats in Montana. The MFWP manages the Swan Drainage for the native westslope cutthroat trout and bull trout. To restore westslope cutthroat trout to Soup Creek, MFWP removed competing eastern brook trout and restocked the creek with westslope cutthroat trout in 1988. The success of this recovery project is under evaluation. Preliminary evidence suggests that eastern brook trout have reestablished themselves in Soup Creek. A summary of the westslope cutthroat recovery project can be found in Project File 603.

In order to meet the recommendations from the Flathead Basin Forest Practices, Water Quality and Fisheries Cooperative Program (the cooperative study report) (Flathead Basin Commission 1991), DNRC has contracted MFWP to collect data and develop index values of existing fisheries habitat quality. The DNRC/MFWP strategy is to first develop the index of juvenile bull trout rearing habitat quality using substrate scoring as described in the cooperative study report.

1. Cilly Creek

Eastern brook trout was the only game species found in Cilly Creek (Weaver 1992). Bull trout were not detected; the combination of extremely low summer--fall discharge and warm water temperature probably prevent bull trout from spawning and rearing in the creek. Westslope cutthroat trout may reside in the higher glacial headwaters area; no survey data are available to confirm the presence or absence of westslope cutthroat trout in the upper reaches. In 1983, only the nonnative eastern brook trout were collected during electrofishing surveys. The numbers of eastern brook trout in Cilly Creek were high compared to other Swan River tributaries: there were 252 eastern brook trout that were greater than three inches long per 300 meters of stream (Leathe 1995, US Fish and Wildlife Service 1995d).

2. Soup Creek

Soup Creek contains nonnative eastern brook trout, westslope cutthroat trout, and bull trout. The abundance and distribution of these species varies within the drainage. In 1983 and 1984, numbers of fish greater than three inches long per 300 meters of stream were measured in the lower reach (Reach 1) of Soup Creek (Leathe 1995). The number of eastern brook trout and cutthroat trout compared to the numbers of these species in other Swan River tributaries were high: 241 and 177, respectively (Table 3.16). The number of bull trout was low at 3 fish per 300 meters of stream. In the upper reaches of

Soup Creek, only westslope cutthroat trout were found in high numbers.

In cooperation with DNRC, MFWP conducted a habitat survey for the upper reach of Soup Creek in June, 1992. The substrate score indicated that juvenile bull trout rearing habitat was barely above the threshold for "threatened" status. Good in-stream cover provided by large woody debris and overhanging vegetation and a moderate number of high quality pools make the upper reach good to excellent habitat for westslope cutthroat trout. Although bull trout rearing habitat is marginal at best, the greatest threat to both bull trout and westslope cutthroat trout in the upper reach of Soup Creek is probably the presence of eastern brook trout (Weaver 1992).

The substrate score for the middle reach of Soup Creek indicated good rearing conditions for juvenile bull trout. During a survey of Soup Creek in October, 1992, two probable bull trout spawning nests were identified in the middle reach of Soup Creek (Weaver 1992).

3. Swan River

The presence of bull trout and cutthroat trout in the Swan River indicates that mitigation measures should be implemented on all streams impacted by the proposal. Mitigation measures should include "Immediate Actions for Bull Trout Recovery" agreed to by the DNRC and the Governor's Bull Trout Restoration Team in 1994 (Montana Dept. of Natural Resources and Conservation 1994).

In July 1994, Tom Weaver, a fisheries biologist from MFWP, completed the substrate scoring for Soup Creek, and spawning surveys and McNeil coring were conducted for bull trout in September, 1994 (Project File 603). Each of these activities were again completed in 1995 for Soup Creek, but results of the 1995 data are yet to be summarized and reported. Results of the 1994 spawning surveys showed no bull trout redds. Although bull trout were occasionally observed throughout the course of the survey, all spawning activity was limited to brook trout redds (Project File 603).

On-going fisheries habitat monitoring for the 1994, 1995, 1996 field seasons included (or will include) substrate scoring, spawning surveys (Table 3.17), and McNeil coring for both migratory westslope cutthroat trout and bull trout. The Flathead Basin Forest Practices, Water Quality, and Fisheries Cooperative Program Study (the cooperative study) showed a direct link between on-the-ground activity (Sequoia Index) and habitat quality (McNeil coring) (Flathead Basin Commission 1991). The cooperative study showed an even stronger tie between spawning habitat quality (percent fines) and embryo survival to emergence. The cooperative study recommended caution when the amount of fine material (percent <6.35 mm) as indicated by McNeil coring exceeded 35 percent. Recommendations call for a red flag at levels above 40 percent. The 1994 McNeil coring sample for Soup Creek showed the fine material (percent <6.35mm) at 34.9 percent (Project file 603). Spawning surveys from other years did not indicate the need for McNeil coring.

Table 3.16 ***Fish Population Estimates for Reach 1 of Soup Creek: Number of Fish > 3 Inches per 300 Meters of Stream***

Species	1983	1989	1990	1992	1994
Westslope Cutthroat Trout	0	144	177	108	72
Eastern Brook Trout	241	266	241	198	192
Bull Trout	3	2	0	12	0
Total	244	412	418	318	264

Table 3.17 ***Soup Creek Spawning Sites Between Highway 83 and Soup Creek Campground***

Species	1982	1992	1994	1995
Westslope Cutthroat Trout	0	0	9	14
Bull Trout	0	2	0	5

I. Air Quality

The project area is within Montana Airshed #2 (Kalispell) and is not in a sensitive impact zone (USDA Forest Service 1992). Air quality within this airshed is considered good. Temporary reductions in air quality primarily occur during residue-burning activities and wildfires. The airshed is managed by the Montana Airshed Group which monitors weather conditions and imposes burning restrictions when poor dispersion and poor ventilation occur.

J. Soils

The Middle Soup Project Area is located within the Swan Valley glacial trough on the east side of the valley floor. Grinell red and green argillite bedrock occurs on the foot slopes and ridges, and the bedrock is overlain by deep glacial till, outwash and alluvial deposits throughout most of the area (Johns 1970). Alluvial soils of somewhat poorly drained silts and gravel occur as riparian stringers adjacent to creeks. Soils are particularly sensitive on wet sites (Table 3.18, Figure 3.6). There are no unique or unstable geologic formations noted on the project area.

Table 3.18 Soils Types in the Project Area: a legend for Figure 3.6

Figure Units	Soil Drainage	Road Limitations	Topsoil Displacement & Compaction	Seedling Establishment	Erosion	Notes
10-3 Alluvial soils	poorly to well drained	mod to severe	severe	good	low	Streamside management guides will be applied.
12 organic soils	poor	severe	severe	poor	slight	These areas will be avoided during harvest.
16 Alluvial Fans 15-30% slope	well drained	low to mod	moderate	fair	slight	Deep gravel and shallow surface soils. Beargrass competition common. Avoid displacement.
26-A-7 deep silty soils from calcareous glacial till; 0-20% slope	well drained	low	moderate (severe if wet)	good	low	Deep productive soil. Fine textured soil remains moist; check soil moisture. Topsoil depth is very important.
26-A-8 deep, silty soils from calcareous glacial till 20-40% slope	well drained	moderate	moderate	good	mod	Deep productive soil. Fine textured soil remains moist; check soil moisture. Topsoil depth is very important.
26-A-9 deep, silty soils in calcareous glacial till; 40-60% slope	well drained	low (some rock)	mod compaction high displacement	good	mod to high	Deep soils, steep slopes limit equipment operations. Cable yarding reduces impacts.
26-C-7 deep glacial till 0-20% slopes	well drained	low	moderate (severe if wet)	good	low	Deep productive soil. Topsoil depth is very important.
26-C-8 deep glacial till 20-40% slope	well drained	moderate	moderate	good	mod	Deep productive soil. Better drainage and longer season of use than 26-C-7 slopes. Topsoil depth is very important.
73 trough wall glacial till and rocky, residual soil slope > 60 %	well drained	mod to severe (rocky, steep)	mod compaction high displacement	fair	mod to high	Steep slopes require cable operation.

FIGURE 3.6 SOILS IN THE PROJECT AREA

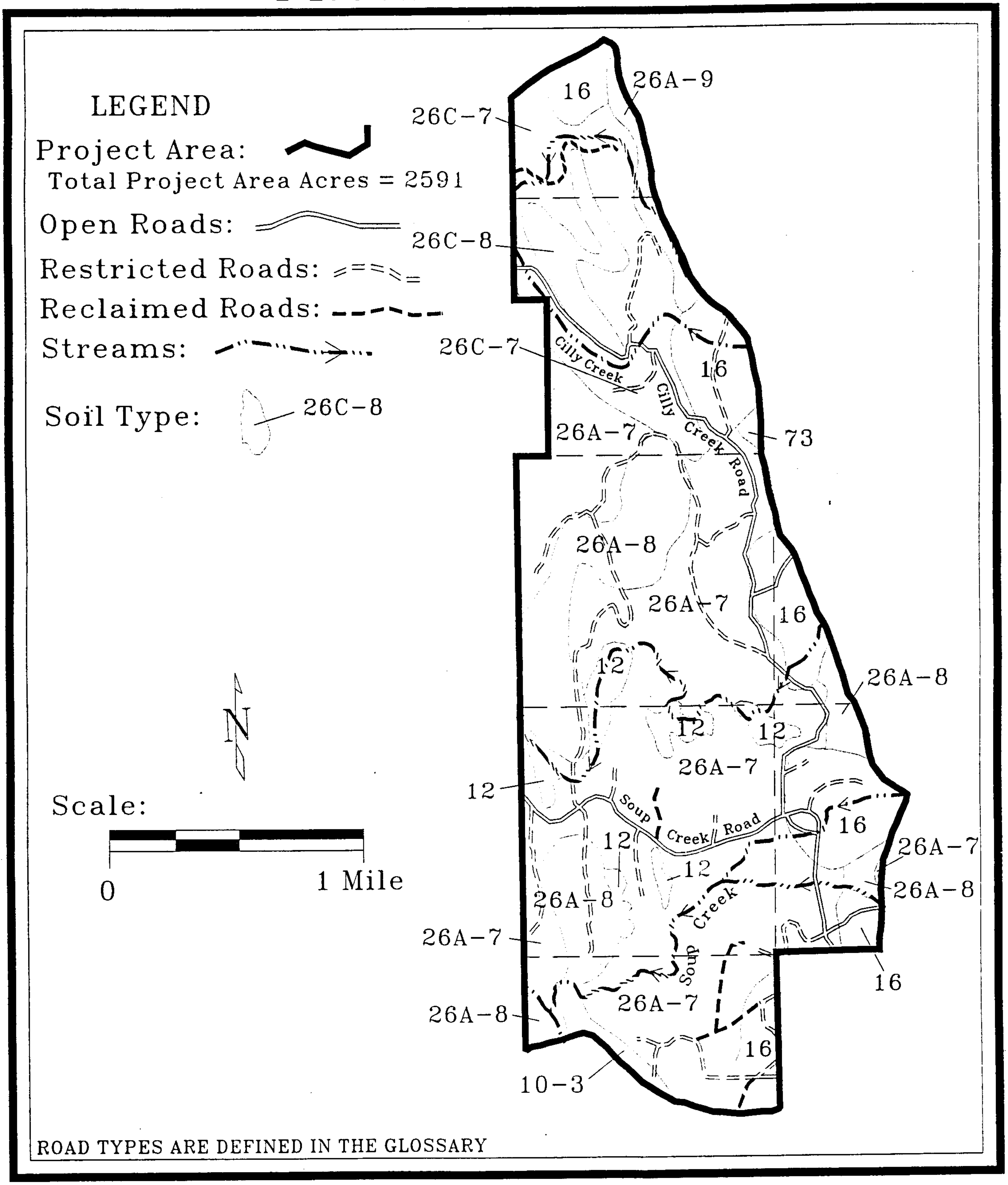


Figure 3.6

K. Noxious Weeds

Spotted knapweed (*Centaurea maculosa*) and common St. Johnswort (*Hypericum perforatum*) occur on dry sites within the project area. Both noxious weeds mainly occur along road edges exposed to sunlight--not in adjacent forest stands--probably due to competition and shading.

L. Aesthetics

Because the visual characteristics are the most perceptible components of "aesthetics," the visual effects on the project area are considered.

The project area cannot be viewed from Highway 83, neighboring residences, Point Pleasant Campground, or Swan Lake because of its low topographic setting along the eastern Swan Valley floor.

The project can be viewed from Soup Creek Campground and local forest roads. Foreground vistas are dominated by stands of timber, past harvest areas, creeks, and rock outcrops along the western flank of the Swan Range.

CHAPTER IV
ENVIRONMENTAL EFFECTS

INTRODUCTION

Chapter IV describes the environmental effects of each alternative on each resource concern. It provides the basis for the summary of effects in Table 2.1. Chapter IV also contains an economic analysis. The economic analysis projects the net monetary return from harvesting timber for each alternative and provides a baseline for comparing the net monetary return from timber harvesting with monetary return from a conservation lease.

I. ENVIRONMENTAL EFFECTS OF THE FOUR ALTERNATIVES ON ECOSYSTEM SUSTAINABILITY

Forest ecosystems are important for more than the timber they produce. Forests provide habitat for many species of plant and animal which have economic or aesthetic value. Many species now recognized as threatened or endangered depend on forests for particular habitat requirements. Other less celebrated species fulfill important functional roles in energy transfer and nutrient cycling that are critical to forest health. If key functional components are not conserved, forest ecosystems will not persist. Consequently, as a management concept, ecosystem sustainability recognizes that all the parts of forest ecosystems are important, and that continued utility of forests for both resource production and non-consumptive purposes depends on continuation of functional ecosystems. The challenge of ecosystem sustainability is to identify the factors that are critical to ecosystem function, and then develop practical guidelines for management that conform to our understanding.

With all that is now known about ecosystem function, development of management plans from a detailed small scale perspective (individual interactions and relationships) quickly overwhelms our ability to reduce the information to a clearly defined set of procedures. Instead some simplifying concepts may be applied that deal with larger scale issues and allow formulation of general guidelines. The first concept we applied is that ecosystems are the smallest ecological unit that can persist independently on a self-sustaining basis. It follows from this that if the ecosystem is intact, then all the parts of the ecosystem must be functioning within their ecologically defined limits. Next is the concept that forest ecosystems within the Rocky Mountains are dynamic systems. They have developed in the presence of repeated disturbance and are adapted to tolerate disturbance within limits of spatial scale, duration, and frequency that are characteristic for particular forest types in different regions. The threat to ecosystem sustainability has been that the scale and frequency of disturbance may have exceeded the limits to which forests have adapted.

These concepts led to three criteria by which the effects of the proposed alternatives on ecosystem sustainability were evaluated:

1) Conservation of mature forest acreage. Total acreage of mature forest has been declining through much of the region. The first step in ecosystem sustainability is to conserve the forest that remains.

2) Reduction of fragmentation. Historically, disturbances were infrequent and influenced large continuous patches of forest. This is much different from recent management practices that have affected small patches of forest at intervals from 50 to 80 years, creating a patch work of small units of increasingly younger successional stage. This fragmentation must be reduced if continuity among forested patches is to be retained.

3) Maintenance of structural complexity and diversity within forest habitats. Another consequence of intensive management has been the simplification of forest habitats. Species diversity and structural diversity have been progressively reduced and must be actively promoted in order to benefit ecosystem sustainability.

A. Methods

1. Analysis Area

We used the same analysis area (the "Ecosystem Sustainability Analysis Area, ESAA) as described in Chapter III to assess both the quantity of specified forest attributes and their spatial juxtaposition. Again, had we used only the Project Area (MSSA), many forest patches would be both inside and outside the area, and problems of interpreting edges and boundaries would have been considerable. Using the ESAA reduces (but does not entirely eliminate) distortions caused by inevitable "edges" within the chosen analysis area. Unfortunately, using the ESAA also has the effect of "diluting" effects of possible timber harvests, which necessarily occur only within a subset of those stands assessed, i.e., the Project Area. Thus, differences among alternatives often appear small. It should be kept in mind, however, that these small differences would appear larger were we to restrict our focus only to those stands within the Project Area.

2. Stand Projection

To assess effects of each alternative on the 3 identified components of ecosystem sustainability, a projection was made of successional changes that would occur within stands through time. The projections move stands along a successional gradient depending on their current age, size class, vigor and projected time interval. Projections are based on professional judgement, experienced growth rates, and past modeling using Stand Prognosis and Stand Projection System (SPS). Stand projections are detailed in Appendix F. In addition to the 8 tree-size classes considered as characterizing the existing condition (and used in Chapter III), this projection includes a "post-old-growth" category, which stands enter after the largely-seral overstory begins dying, overhead canopy declines, and the climax dominants begin to take over the stand. "Post-old-growth" stands maintain some of the characteristics of old-growth (e.g., abundance of snags and down-woody material) but lack others (high canopy coverage of large-diametered overstory dominants).

We stress that this projection is not a prediction, much less a commitment to future conditions. Rather, it represents our best understanding of the trajectory of these stands in the absence of disturbance (fire, windthrow, insect or disease epidemic, logging). It is useful for depicting the dynamics underlying these stands, but individual stands will not conform if (or, more accurately, when) disturbance occurs. Nonetheless, natural disturbances are unpredictable, and man-made disturbances (i.e., timber harvest), although predictable, cannot be made stand-specific at this time. Further, we stress that projections might well appear quite differently had we applied repeated harvests, similar to each of the alternatives, at some selected time intervals, rather than applying only a 1-time treatment, followed by growth in the absence of disturbance.

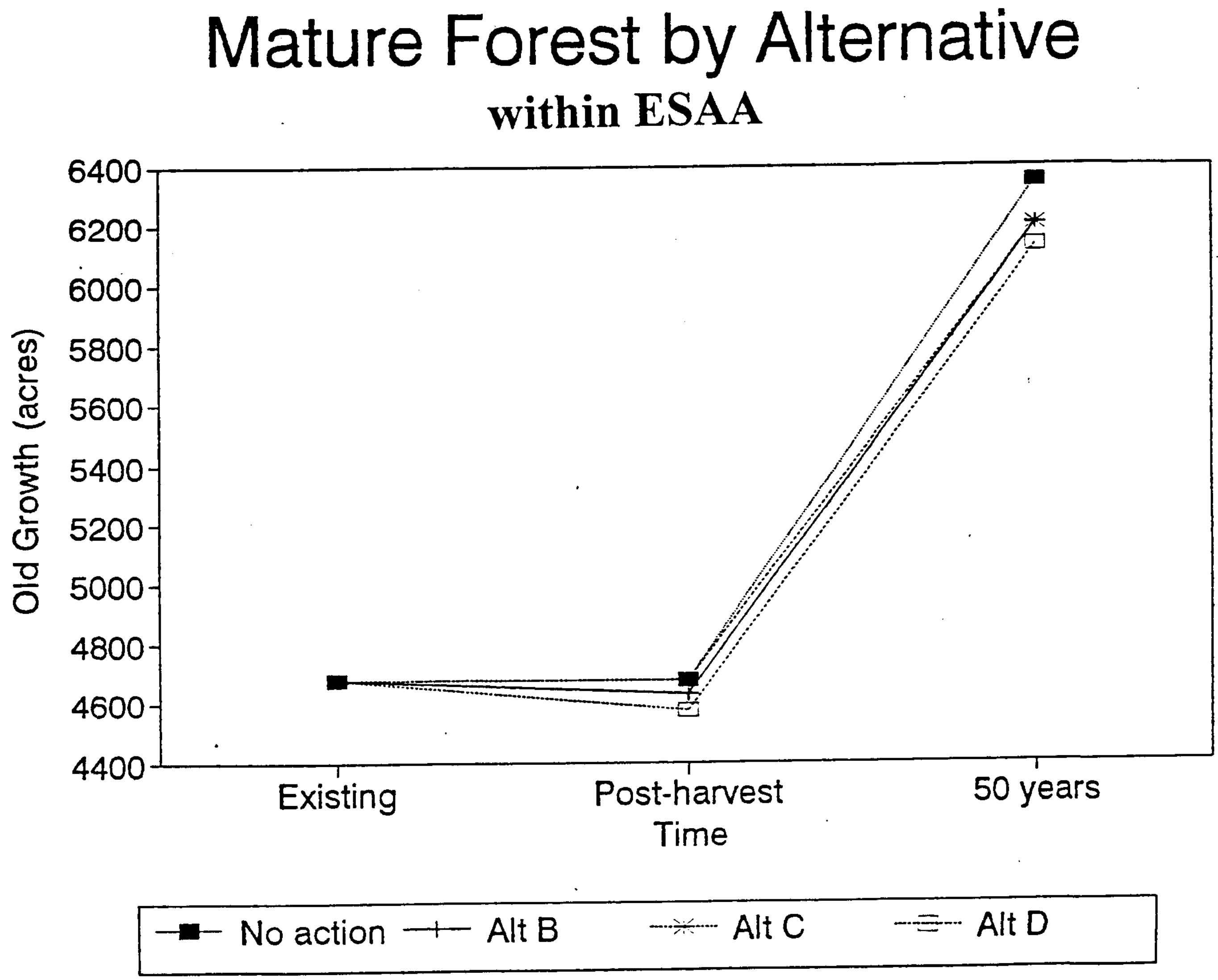
B. Conserving Mature Forests

Under Alternative A, mature forest would remain unchanged during the period immediately after harvest because no timber harvesting would occur. All old-growth stands and surrounding mature forest areas would be preserved. Initially, at least, this alternative would conserve the mature forest areas within the sale boundary, and thus increase the total area of mature forest in the sale area. In the following 50 years, mature forest is projected to increase to roughly 6,347 acres, the most of any of the Alternatives (Figure 4.1), as younger aged stands mature sufficiently to progress into sawtimber status.

Alternative B proposes structural enhancement timber harvests over a large portion of the existing old-growth stands within the project area. Where structural enhancement cuts are applied, no road building will occur and 90 percent canopy closure will remain after harvest. As a result, where structural enhancement cuts (Figure 2.2) are applied within old growth, none of the stands will be converted to younger stand types. Where moderate reserve regeneration cuts are applied (units B1 and B2) mature stands will be converted to younger stand types. Where heavy reserve regeneration cuts are applied (units B3-B7) a major portion (80 square feet of basal area) of the mature overstory component is maintained. Heavy reserve harvesting is designed to maintain the mature component of a stand while increasing structural diversity through establishment of a younger understory class. Thus, under Alternative B, mature forest declines slightly immediately post-harvest, but by 50 years later is projected to increase to 6,203 acres. Structural enhancement harvests within existing old-growth stands are intended to prolong the longevity of existing old-growth. More than sixty years of fire suppression has allowed stocking rates to increase markedly in old-growth stands as shade tolerant species established beneath the existing canopy. Selective removal of some trees should reduce moisture and nutrient competition and prolong the vigor of the established canopy. Creation of small gaps will also restore spatial and structural heterogeneity within old-growth stands

Under Alternative C, only 2 units (Figure 2.3) would be affected. Unit C1, a 12.9 acre parcel, is currently classified as multi-storied and would be treated by a regeneration harvest with moderate reserve. Unit C2, with 44.6 acres, is currently classified as sawtimber and would be treated by a regeneration harvest with heavy reserve. In the short term, harvesting within these units would not alter existing old growth stands as neither is classified as such. The pattern of mature forest under Alternative C is thus a

FIGURE 4.1


Mature Forest by Alternative
within ESAA
6400
6200
6000
5800
5600
5400
5200
5000
4800
4600
4400
Old Growth (acres)
Existing
Post-harvest
50 years
Time
No action
Alt B
Alt C
Alt D

hybrid of the preceding two: mature forest acreage remains unchanged immediately post-harvest, as in Alternative A, but achieves the same level as that of Alternative B in 50 years.

Under Alternative D, several units (Figure 2.4) would be treated in a similar fashion as that proposed in Alternative B. Units D8 and D9 would be treated by regeneration harvesting with heavy reserve in keeping with the three ecosystem sustainability criteria mentioned at the beginning of this chapter. Units D6 and D7 would receive regeneration harvesting with moderate reserve also meeting the ecosystem sustainability criteria. The biggest effect which this alternative would have on the conservation of mature forest as envisioned for ecosystem sustainability would be in units D1 and D2 where regeneration harvest with light reserve would be applied. Both of these stands are currently classified as old growth. Although the acreages involved here are relatively small they would be lost as old growth acreage under this alternative. Units D3, D4, and D5 (saw timber and old-growth stands) would also receive more heavy harvesting in Alternative D than in Alternative B. This would also decrease the amount of acreage conserved as mature forest and would significantly reduce crown density in these units compared to that proposed under Alternative B. In the same manner Alternative D would more greatly impact units D10 and D11 than would be the case under Alternative B. The significant old growth acreage here lies within the second largest block of mature forest in the ESAA. The silvicultural treatment suggested for these units would set this acreage back from their existing old growth classification most likely more than 50 years. In summary then, acreage of mature harvest would be reduced slightly post-harvest under Alternative D, but increase to 6,129 acres by 50 years post-harvest, slightly less than the levels under Alternatives B and C.

The patterns for all 4 alternatives are largely replicated when the "mature" class is considered to include the "post-old-growth" category (Figure 4.2), although raw acreages are higher, and differences among the alternatives are smaller.

Considering only stands classified as "old growth", the pattern changes dramatically, however (Figure 4.3). Old growth remains constant immediately post-harvest under both Alternatives A and C, dropping by approximately 4% under Alternative B and by approximately 9% under Alternative D. However, by 50 years post-harvest, stands classified as "old growth" are projected to decline dramatically under all alternatives, because of the break-up and succession of seral species to their climax successors.

FIGURE 4.2

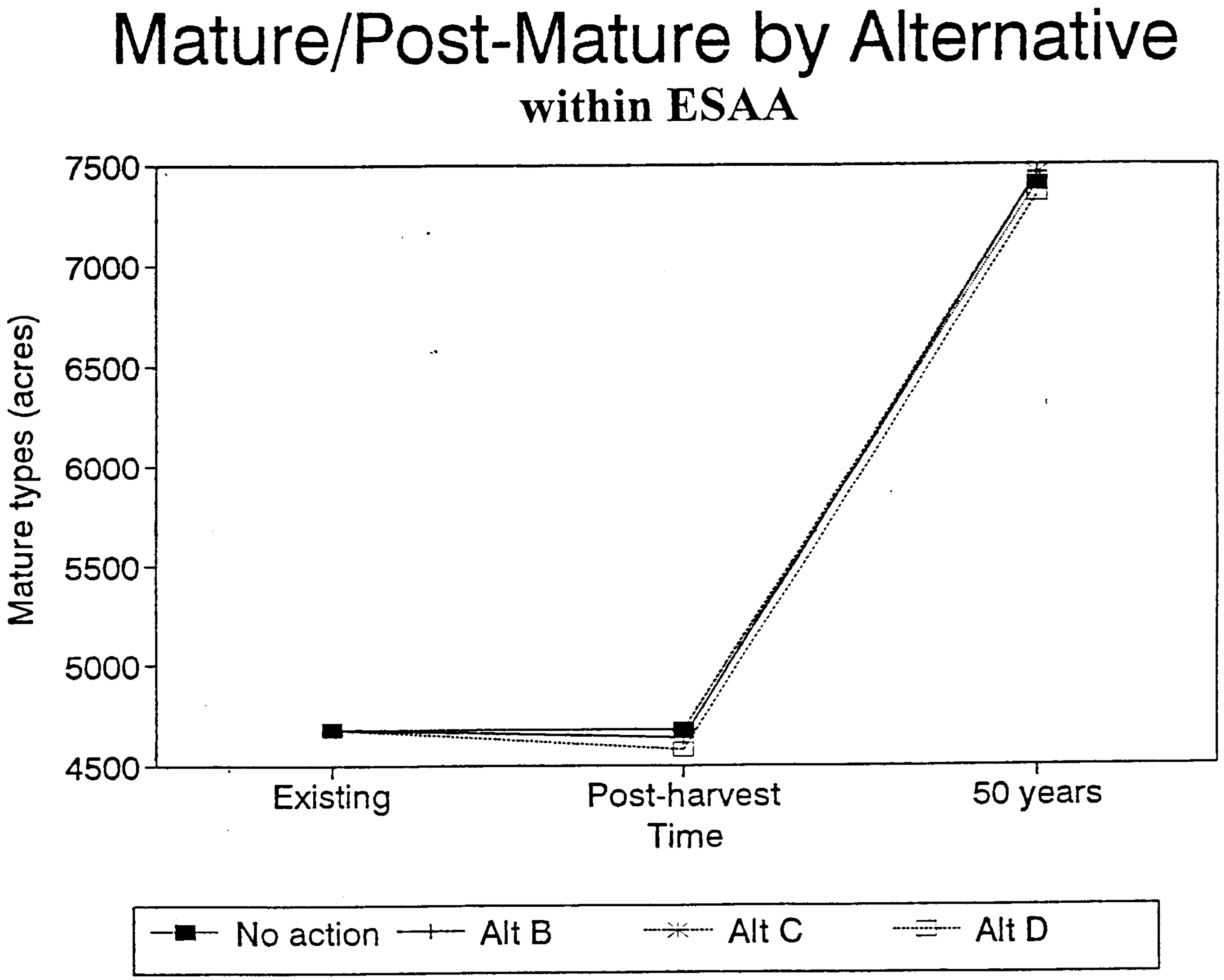
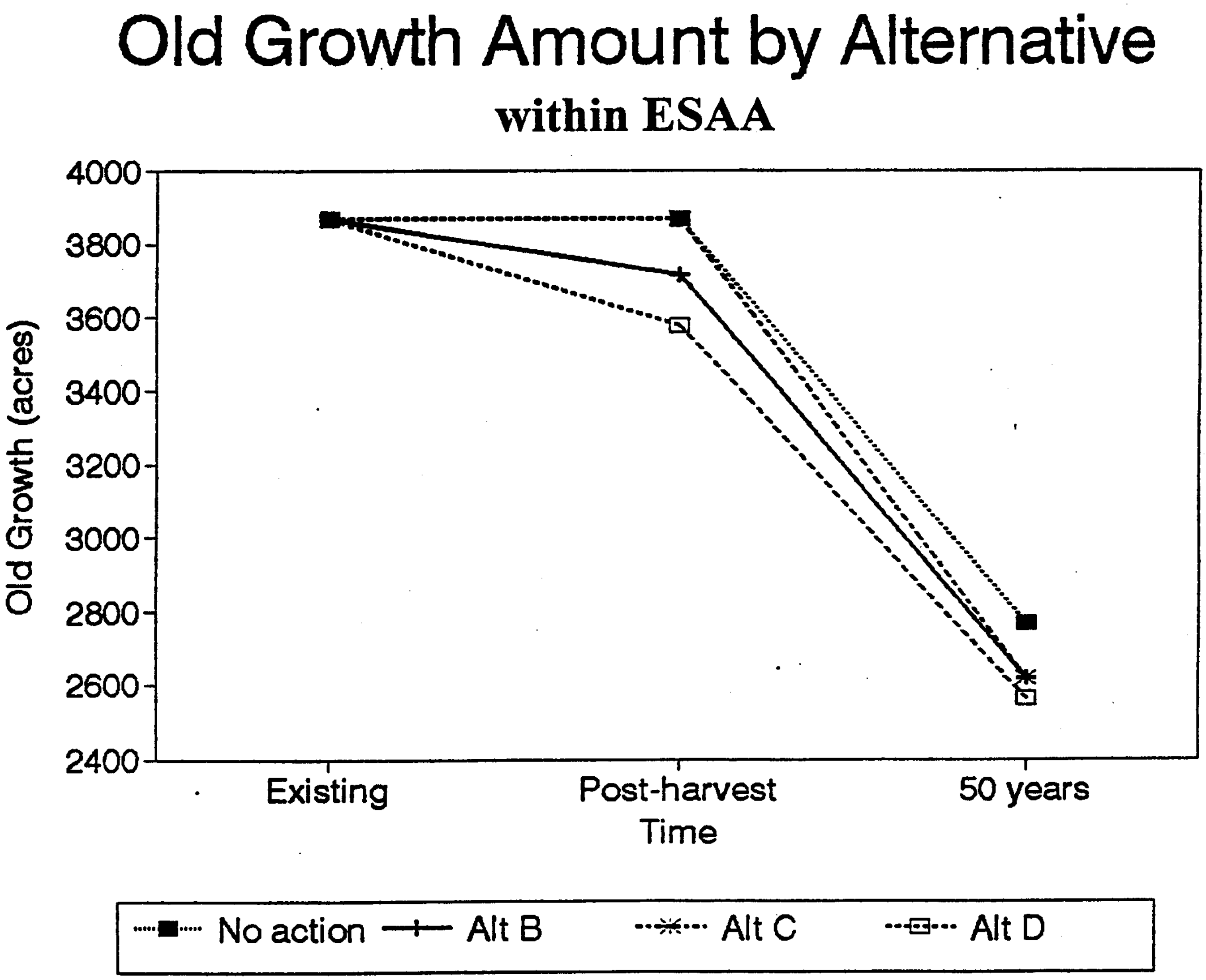

Mature/Post-Mature by Alternative
within ESAA
Mature types (acres)
7500
7000
6500
6000
5500
5000
4500
Existing
Post-harvest
50 years
Time
No action
Alt B
Alt C
Alt D

FIGURE 4.3


Old Growth Amount by Alternative
within ESAA
4000
3800
3600
3400
3200
3000
2800
2600
2400
Old Growth (acres)
Existing
Post-harvest
50 years
Time
No action
Alt B
Alt C
Alt D

Considering the broader category of "mature" forests, the reduction in "old-growth" due to it's transformation into "post-old-growth" is projected to be more than compensated by maturation of younger stands into the "sawtimber" category. However, sawtimber and old-growth are not equivalent forest types with respect to structure and composition among other attributes. Much longer intervals are required, on the order of 100 to 150 years, for sawtimber stands to achieve old-growth status. During that interval much more of the old-growth can be expected to break up, creating a long period of time when net old-growth acreage on the ESAA would decrease. By 150 years, the amount of old-growth under any Alternative is projected to exceed current levels (see Project File 602 for results of these longer projections).

C. Spatial Characteristics of Forested Patches

Alternative A, no action, does nothing either to exacerbate or alleviate currently existing problems in spatial characteristics of forested patches. Alternative B takes as a major focus the treatment of spatial considerations. Thus, location and type of treatments were designed to minimize increasing existing fragmentation, and ultimately, to reduce it. Treatments proposed for several units would decrease fragmentation by placing acreage into age/size class categories more consistent with surrounding stands. Alternative C was designed primarily to avoid entering existing old-growth stands; it thus optimizes one element of ecosystem sustainability, but does not explicitly treat the others. Alternative D in general does not address existing habitat fragmentation in the ESAA. For example, treatments proposed on units D1, D2, D10 and D11 (Figure 2.4) would all increase fragmentation by breaking up existing blocks of old growth. In the case of units D1 and D2 there would be additional sharp fragmentation created setting this acreage back to the sapling category. However, treatments proposed for units D3, D4, and D5 would decrease fragmentation by placing this acreage into the sapling category more consistent with surrounding young-pole stands. These units currently exist as highly fragmented, narrow and isolated strips of old growth.

Patch Size. The pattern of patch sizes remains largely similar among the 4 alternatives immediately post-harvest (Figure 4.4). Most patches are small, and relatively few are > 100 acres in size. At 50 years post-harvest, a few changes in the distribution of patch sizes become evident (Figure 4.5). While most patches remain relatively small (< 50 acres), all alternatives at 50 years post-harvest show a secondary peak at approximately 200 acres. The number of very small (< 10 acres) patches is most reduced under Alternative D, but the number of moderately small patches (40-70 acres) is also smaller than under the other alternatives. As a result, mean patch size, while increasing in 50

FIGURE 4.4

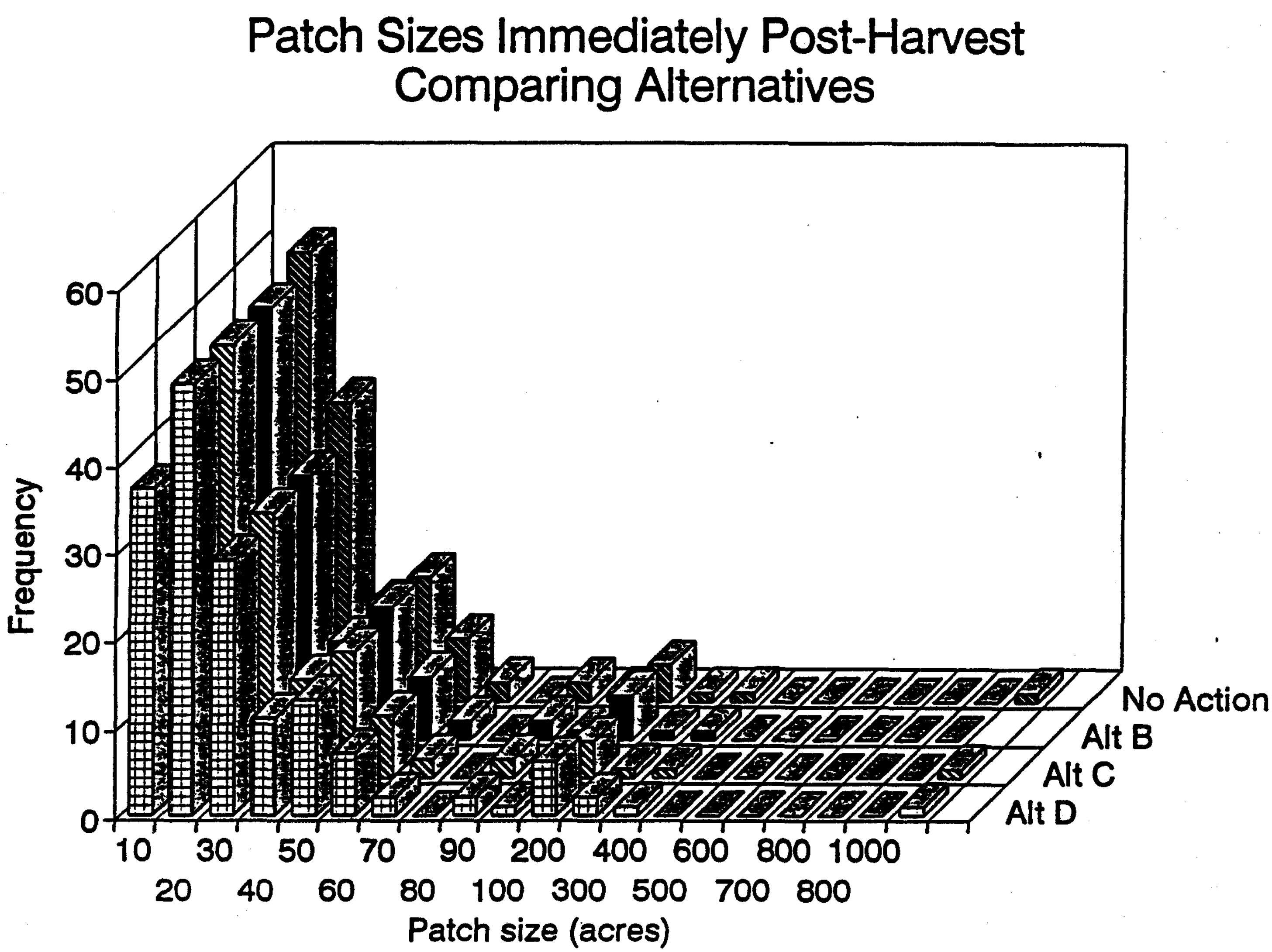
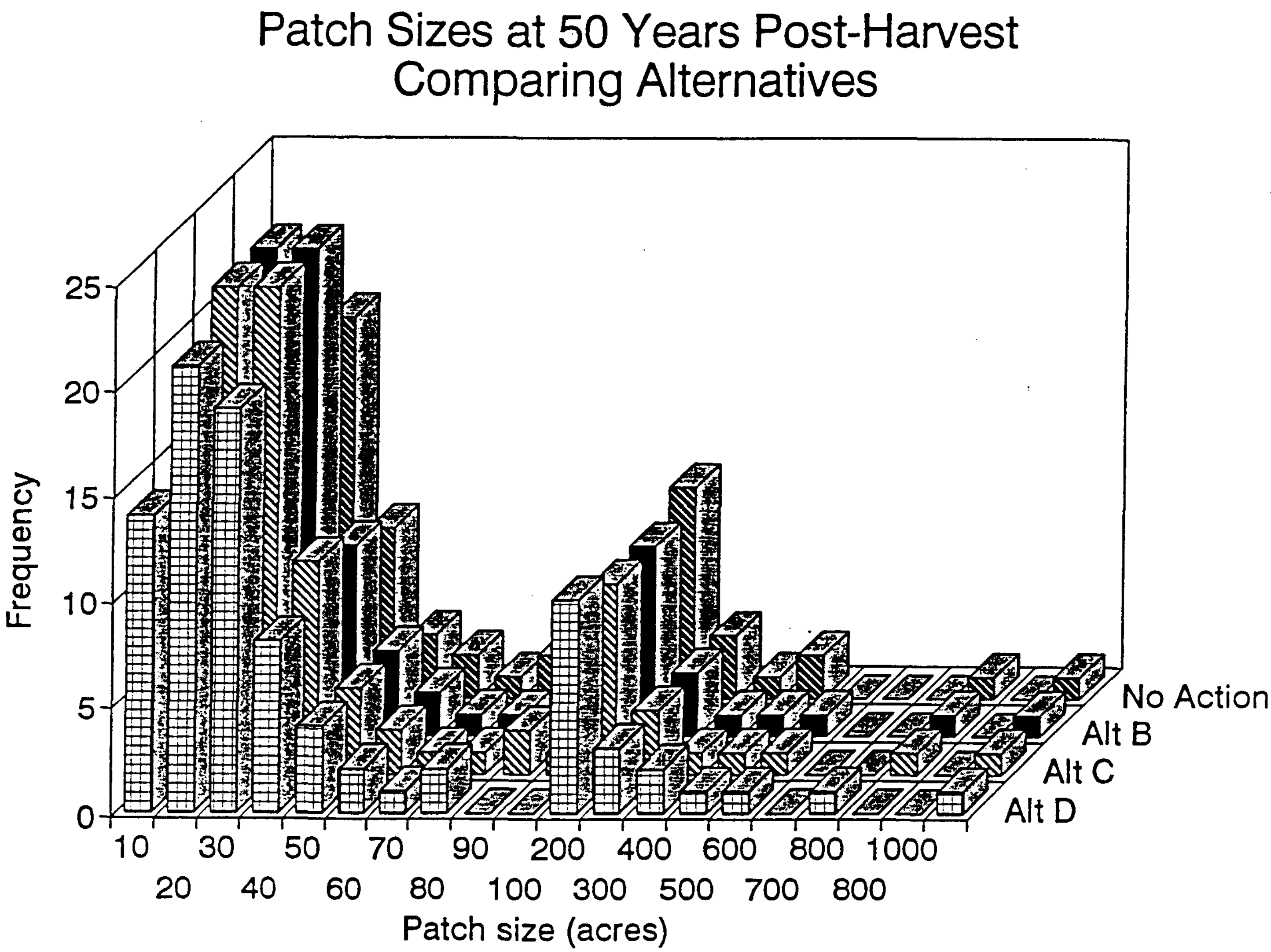

Patch Sizes Immediately Post-Harvest
Comparing Alternatives
Frequency
0
10
20
30
40
50
60
10 30 50 70 90 200 400 600 800 1000
20 40 60 80 100 300 500 700 800
Patch size (acres)
No Action
Alt B
Alt C
Alt D

FIGURE 4.5


Patch Sizes at 50 Years Post-Harvest
Comparing Alternatives
Frequency
0
5
10
15
20
25
10
20
30
40
50
60
70
80
90
100
200
300
400
500
600
700
800
800
1000
Patch size (acres)
No Action
Alt B
Alt C
Alt D

years under all alternatives, is projected to remain smallest (87.8 acres) under Alternative D (Figure 4.6). Mean patch size is projected to be largest (96.4 acres) under Alternative A, while Alternatives B and C are projected to have similar (95.2 acre) mean patch sizes 50 years post-harvest.

Patches are considerably larger when classified by the merged types "mature", "immature", and "nonforested", and, with the exception of Alternative D at 50 years, mean sizes are more similar among alternatives than when considered by tree-size classes (Figure 4.7). At 50 years post-harvest, Alternative D is projected to have substantially smaller mean patch size (304 acres) than the three other alternatives (376.4 acres).

Patch Juxtaposition. The analysis of existing condition suggested that older types tend to be disproprotionately located adjacent to younger types, and that adjacency among similar types is under-represented (Table 3.5b). Projection of the stands through time suggests that these sharp contrasts would be softened post-harvest under any of the alternatives, although at different rates of speed.

Regeneration harvests planned as part of Alternative B are intended to reduce fragmentation by creating larger areas of similar aged forest in several highly fragmented regions of the project area. The regeneration/heavy reserve harvests would reduce five small fragments of old-growth to multi-storied stands that in 50 years would be more similar to surrounding old-pole stands. Regeneration/ light reserve harvests would be applied to two narrow strips of old-growth that are bounded by old-pole stands.

Except for Alternative A (no action), the sharp edges between "old-growth" and the "sapling" and "grass/shrub/seedling" classes are softened post-harvest, most dramatically by Alternative B, and least so by Alternative C (Figure 4.8). (Positive values in Figure 4.8 indicate over-representation of this type of adjacency relative to that expected if adjacency was proportional to type abundance). Similarly, immediately post-harvest, Alternative B moves the realized adjacency between "old-growth" and "sawtimber" stands closest back to the expected level (see Methods under Spacial Characteristics of Forest Patches, pg III-9 in chapter III), while Alternative A makes no change (Figure 4.9). However, by 50 years post-harvest, the amount of adjacency between "old-growth" and "sawtimber" stands under Alternative D is projected to exceed that expected based on the abundance of these types, while under Alternative B the adjacency rises to nearly the expected level. The slowest rise toward expected levels of adjacency is projected to occur under Alternative C.

FIGURE 4.6

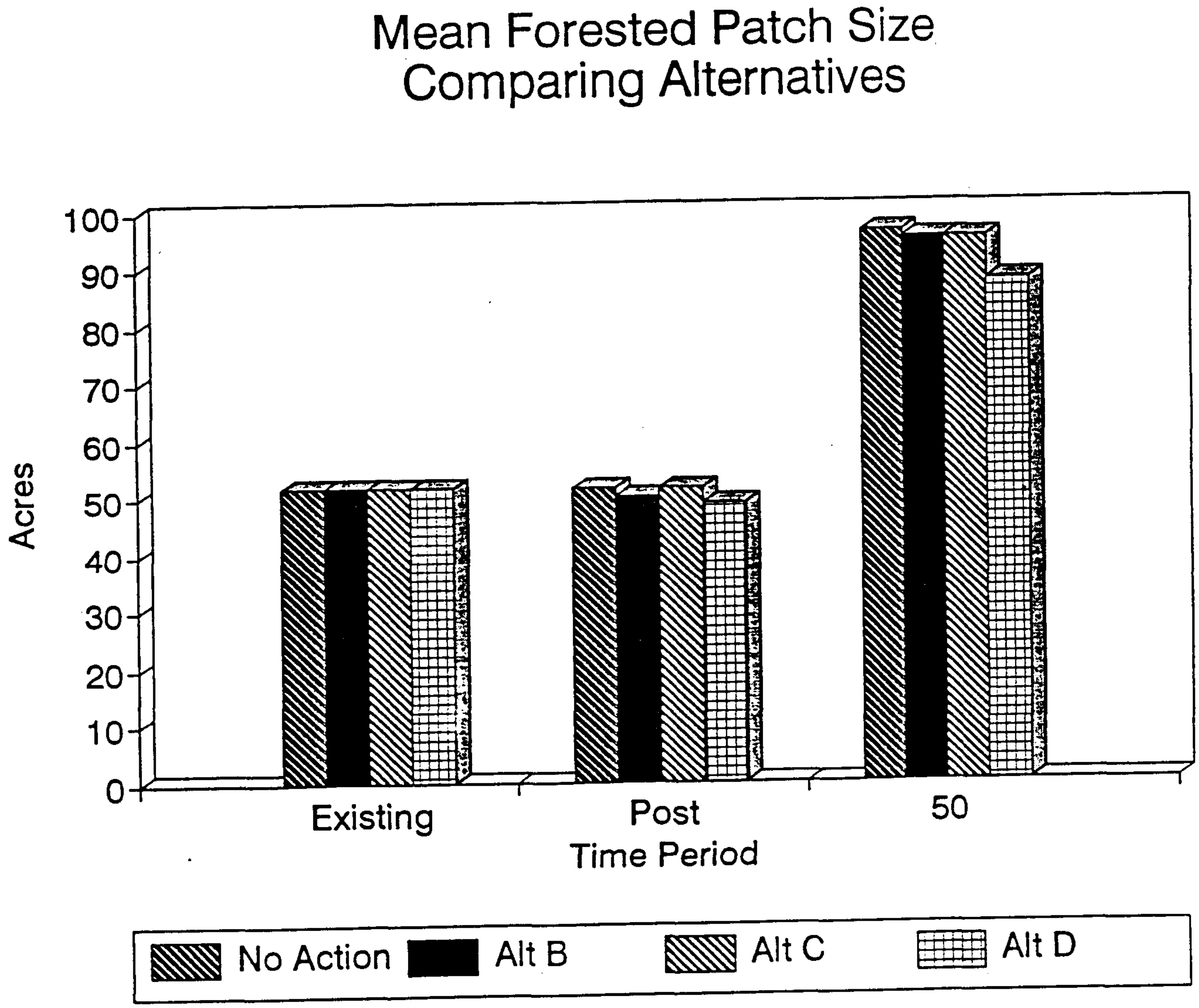

Mean Forested Patch Size
Comparing Alternatives
Acres
100
90
80
70
60
50
40
30
20
10
0
Existing
Post
50
Time Period
No Action
Alt B
Alt C
Alt D

FIGURE 4.7

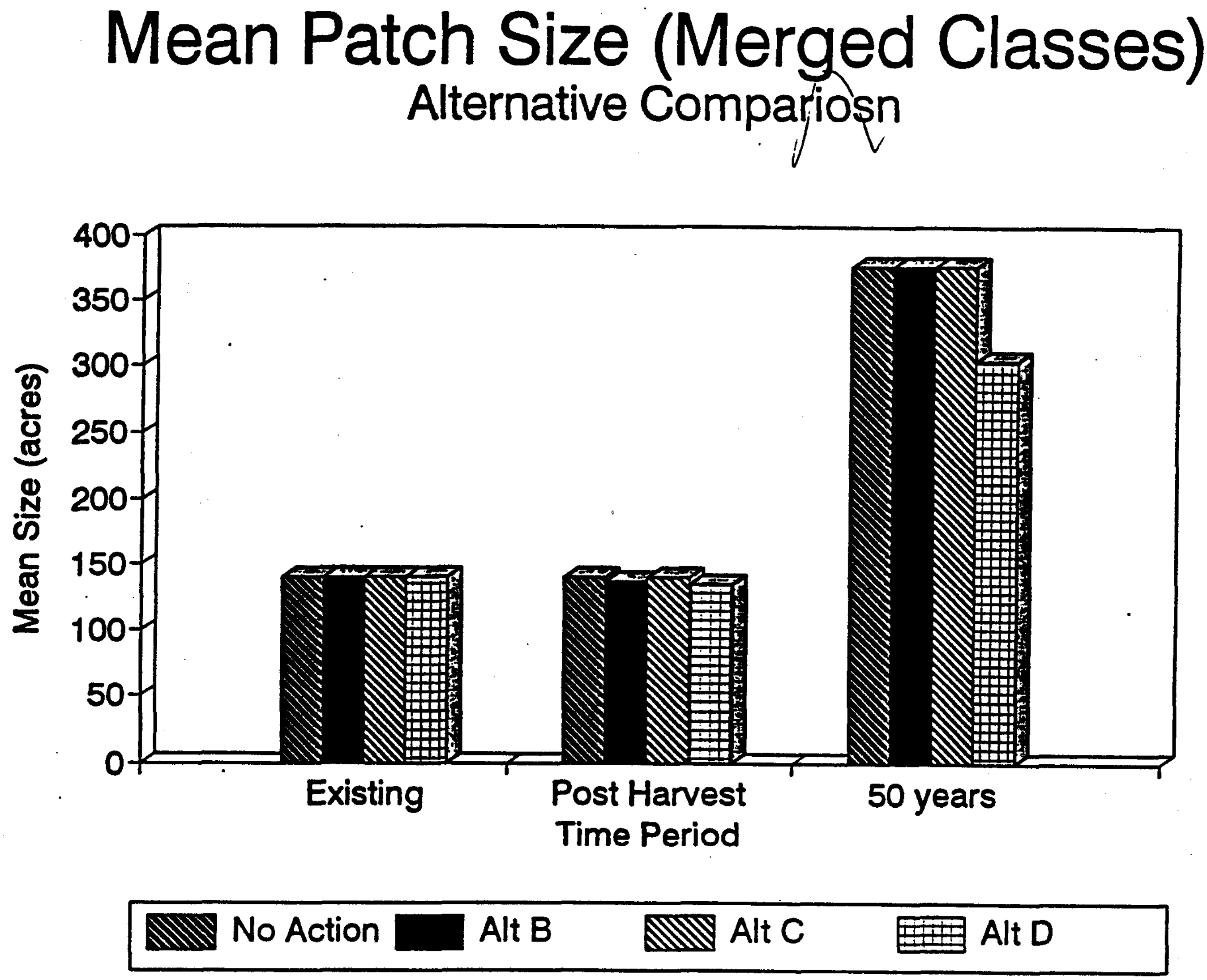

Mean Patch Size (Merged Classes)
Alternative Compariosn
Mean Size (acres)
400
350
300
250
200
150
100
50
0
Existing
Post Harvest
Time Period
50 years
No Action
Alt B
Alt C
Alt D

FIGURE 4.8

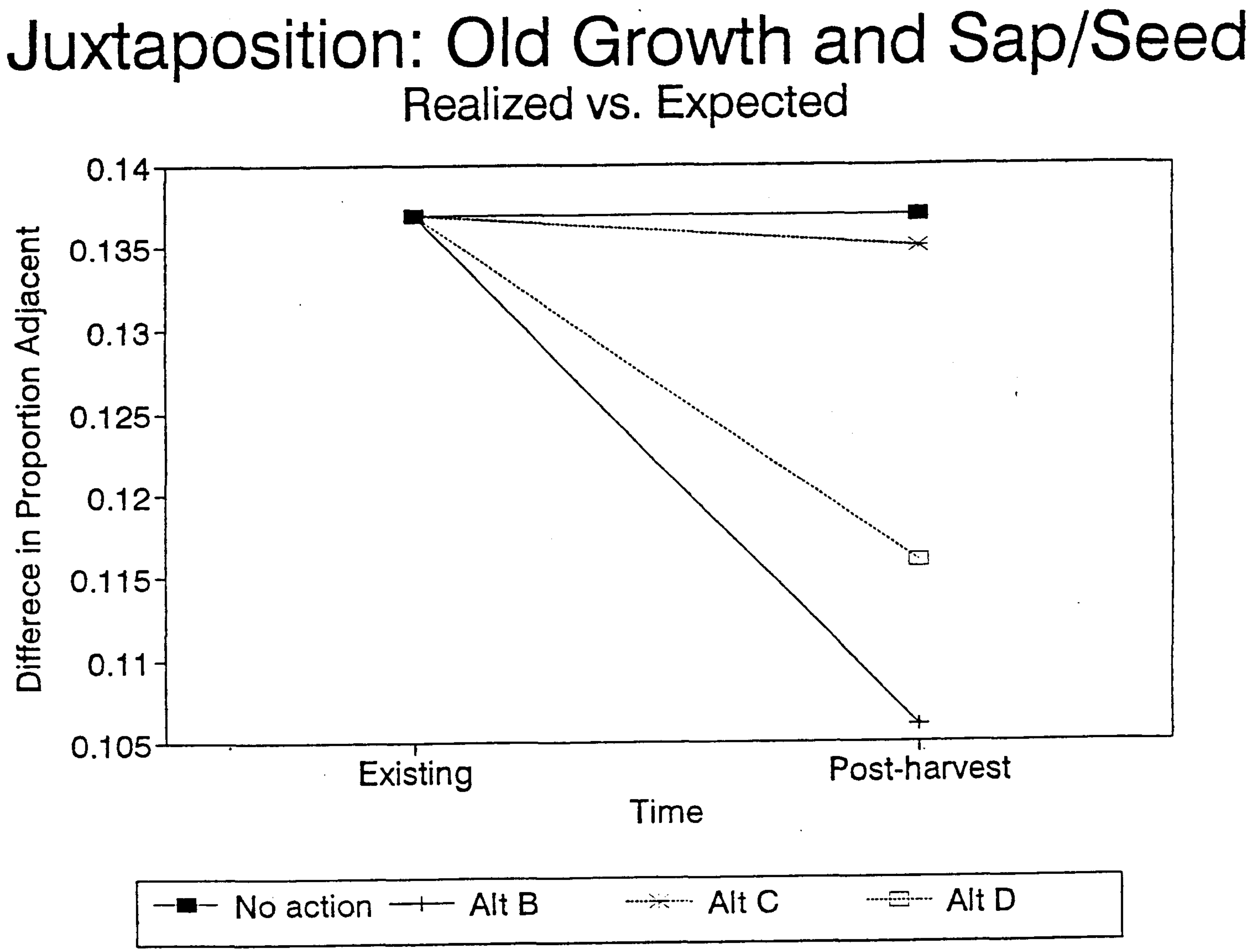
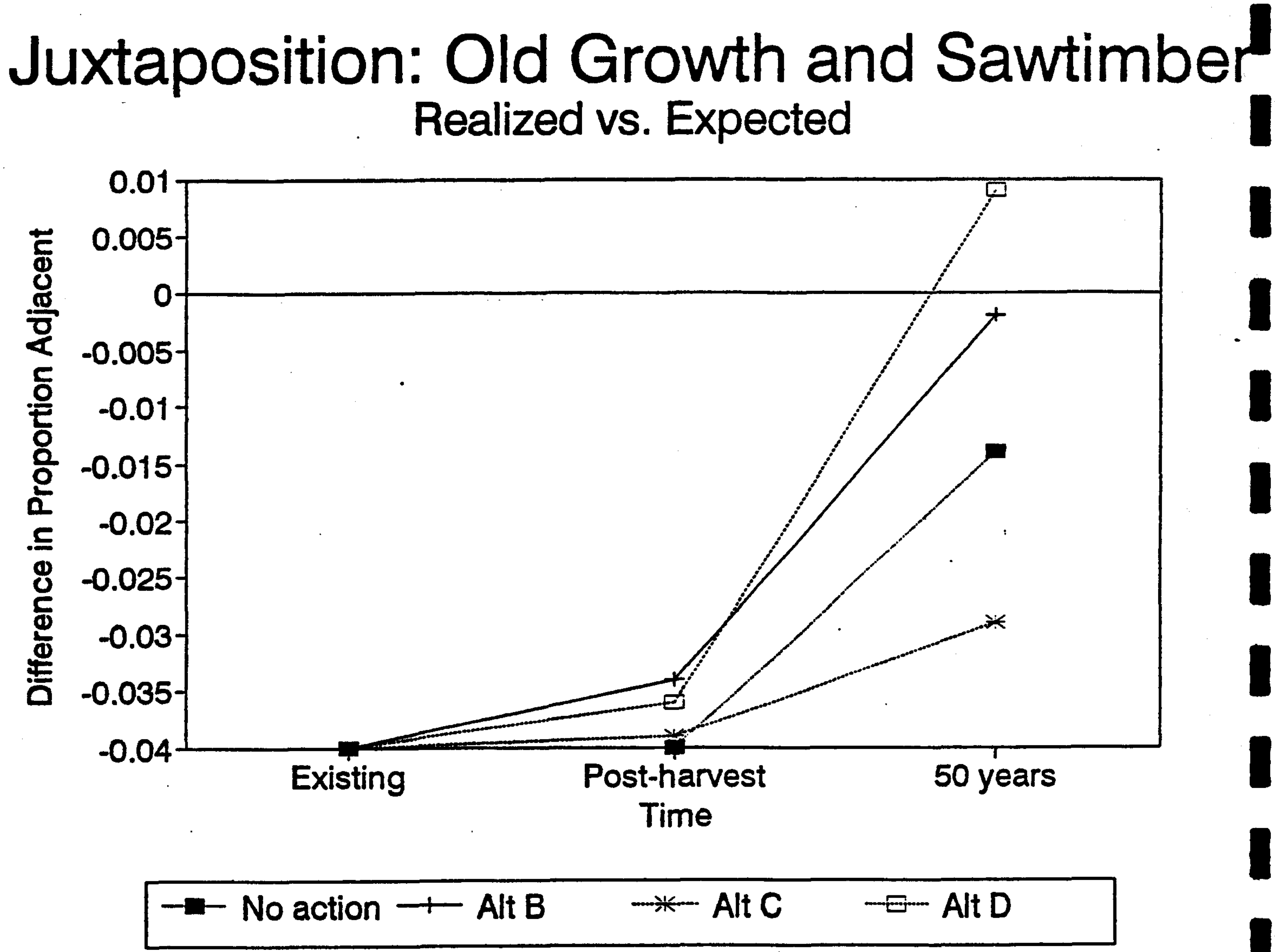

Juxtaposition: Old Growth and Sap/Seed
Realized vs. Expected
Differece in Proportion Adjacent
0.14
0.135
0.13
0.125
0.12
0.115
0.11
0.105
Existing
Post-harvest
Time
No action
Alt B
Alt C
Alt D

FIGURE 4.9


Juxtaposition: Old Growth and Sawtimber
Realized vs. Expected
Difference in Proportion Adjacent
0.01
0.005
0
-0.005
-0.01
-0.015
-0.02
-0.025
-0.03
-0.035
-0.04
Existing
Post-harvest
50 years
Time
No action
Alt B
Alt C
Alt D

Patch Shape. Analysis of the existing condition suggested that old-growth patches are of more complex shape (mean index: 2.37), and seral type patches of simpler shape (mean indices about 1.2 - 1.6) than the historical average of 1.90 calculated by Hart (1994; Table 3.3). Shape indices of mature types decline (i.e., shapes become simpler) under all Alternatives, but most dramatically under Alternative B and C (Figure 4.10). Shape indices of mature patches become somewhat smaller (i.e., have a greater amount of area per distance of edge) under Alternative D, but at 50 years, match the shape complexity of those under Alternative A. Essentially the reverse pattern is seen among shapes of seral types (Figure 4.11), where patches become more complex with time, particularly as projected through 50 years without additional harvest.

Interior Core Habitat. The amount and location of mature interior core (areas > 100 meters from non-mature types no less than 123.5 acres in size) remains essentially constant immediately post-harvest under all alternatives considered (Figure 4.12). At 50 years post-harvest, maturation of existing stands into the sawtimber class is projected to create considerably expanded acreage of mature interior core, to no less than 5,662 acres (under Alternative D) and as much as 5,847 acres (under Alternatives A,B and C; Figure 4.12). While still predominately located outside of the Project Area per se, mature interior core areas become more abundant in the northern and southern ends of the ESAA by 50 years post-harvest (Figure 4.13).

Considering only those interior core habitats classified as "old-growth", the projected pattern appears somewhat different (Figure 4.14). Acreage and location of these habitats remain unchanged through time under both Alternatives A and C. Under Alternative B, "old growth" interior core is projected to decline by roughly 3% immediately post-harvest, but to return to essentially its present level by year 50. Under Alternative D, "old growth" interior core is projected to decline by roughly 22% immediately post-harvest, but to again return to existing levels at year 50.

D. Structural and Compositional Diversity

The effects of Alternative A (no action) on structural and compositional diversity are difficult to anticipate, and were not modeled explicitly. Certainly, as pole timber classes mature, shade tolerant tree species will begin to establish, increasing diversity in those stands. The same will continue to occur in mature forest stands, however, increasing the dominance of Douglas-fir and firs in those stands, decreasing diversity. Structural complexity may increase over the short term as stands age and develop a multi-storied canopy, and as self-thinning and other mortality increase the numbers of snags and

FIGURE 4.10

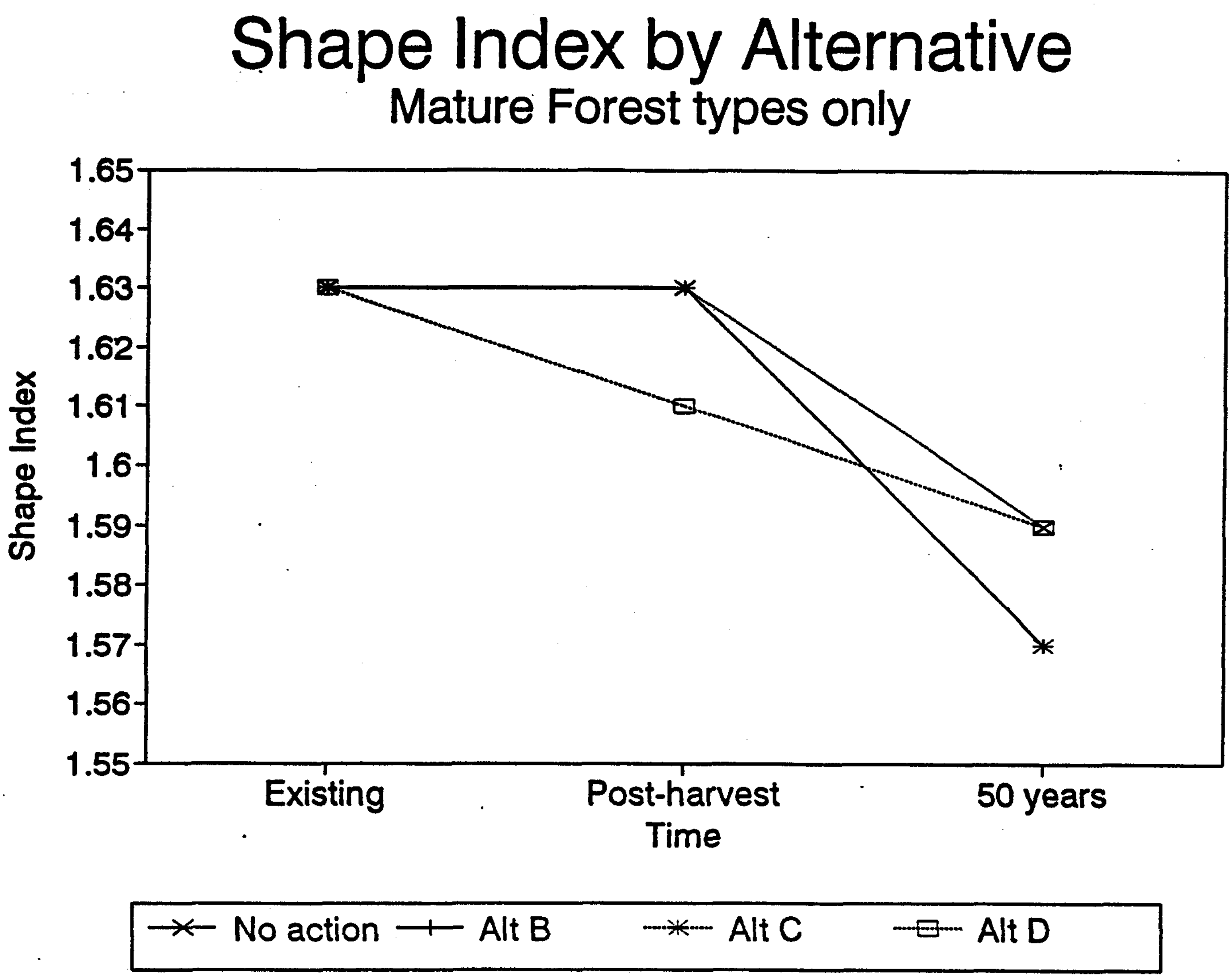

Shape Index by Alternative
Mature Forest types only
Shape Index
1.65
1.64
1.63
1.62
1.61
1.6
1.59
1.58
1.57
1.56
1.55
Existing
Post-harvest
50 years
Time
No action
Alt B
Alt C
Alt D

FIGURE 4.11

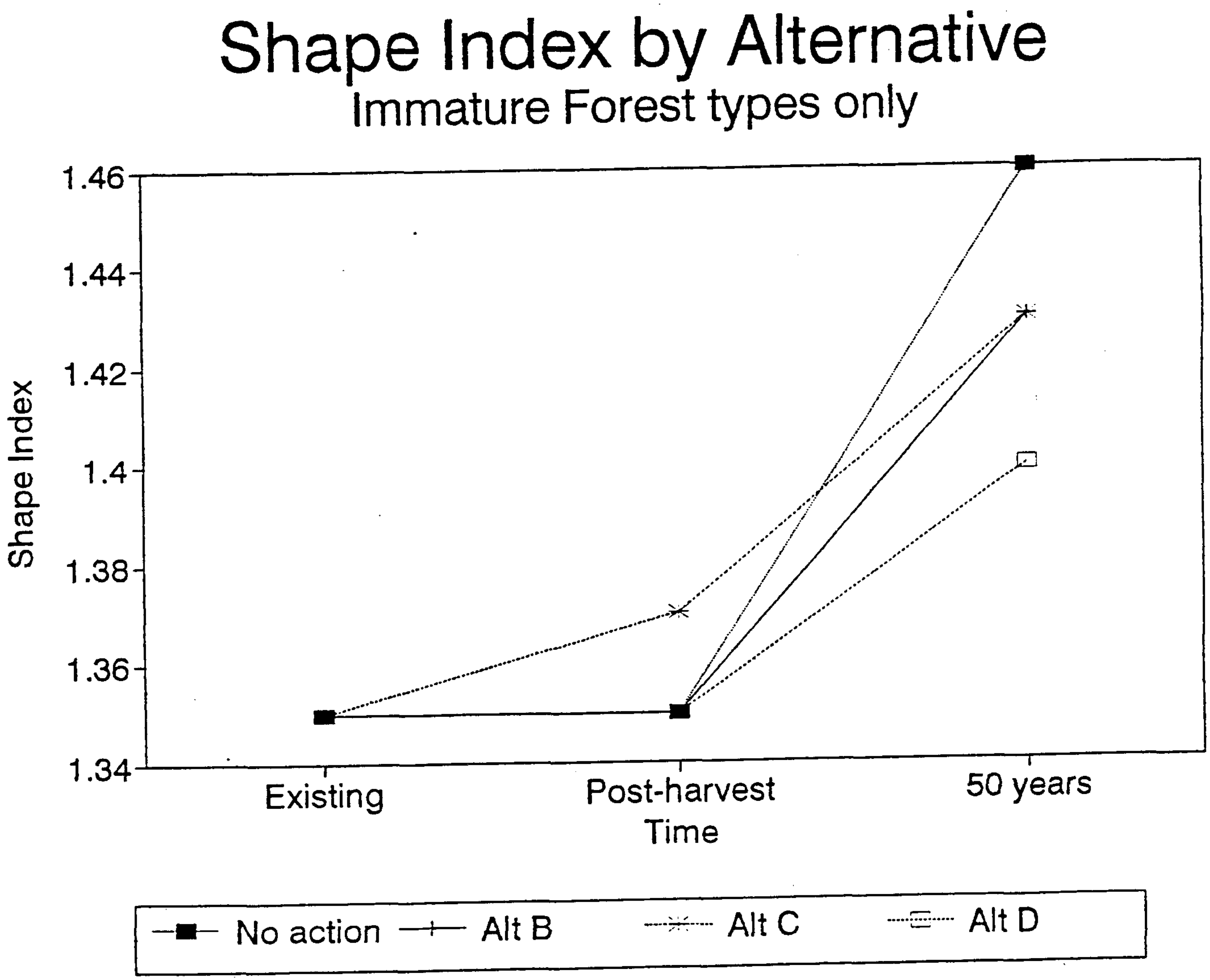

Shape Index by Alternative
Immature Forest types only
Shape Index
1.46
1.44
1.42
1.4
1.38
1.36
1.34
Existing
Post-harvest
50 years
Time
No action
Alt B
Alt C
Alt D

FIGURE 4.12

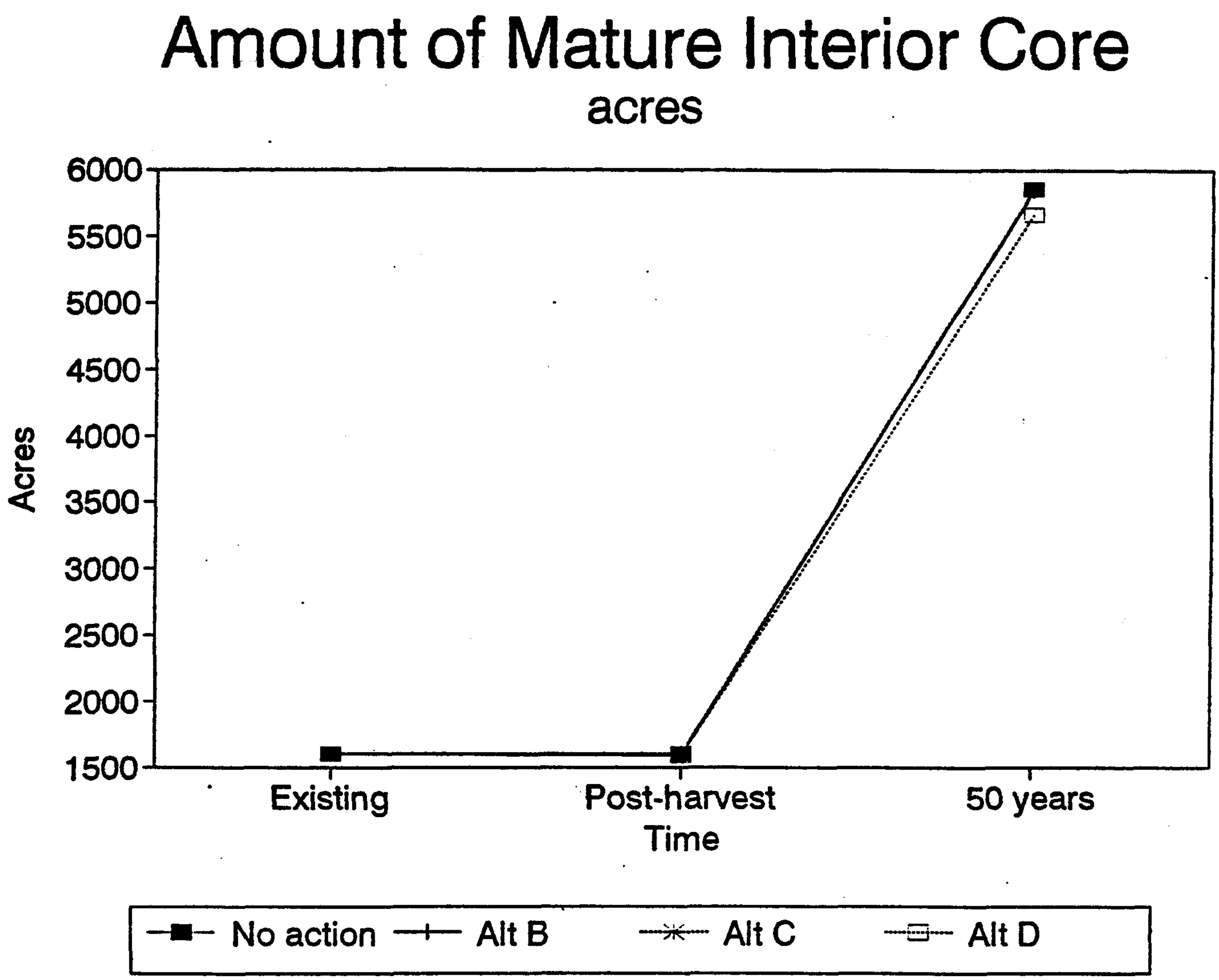
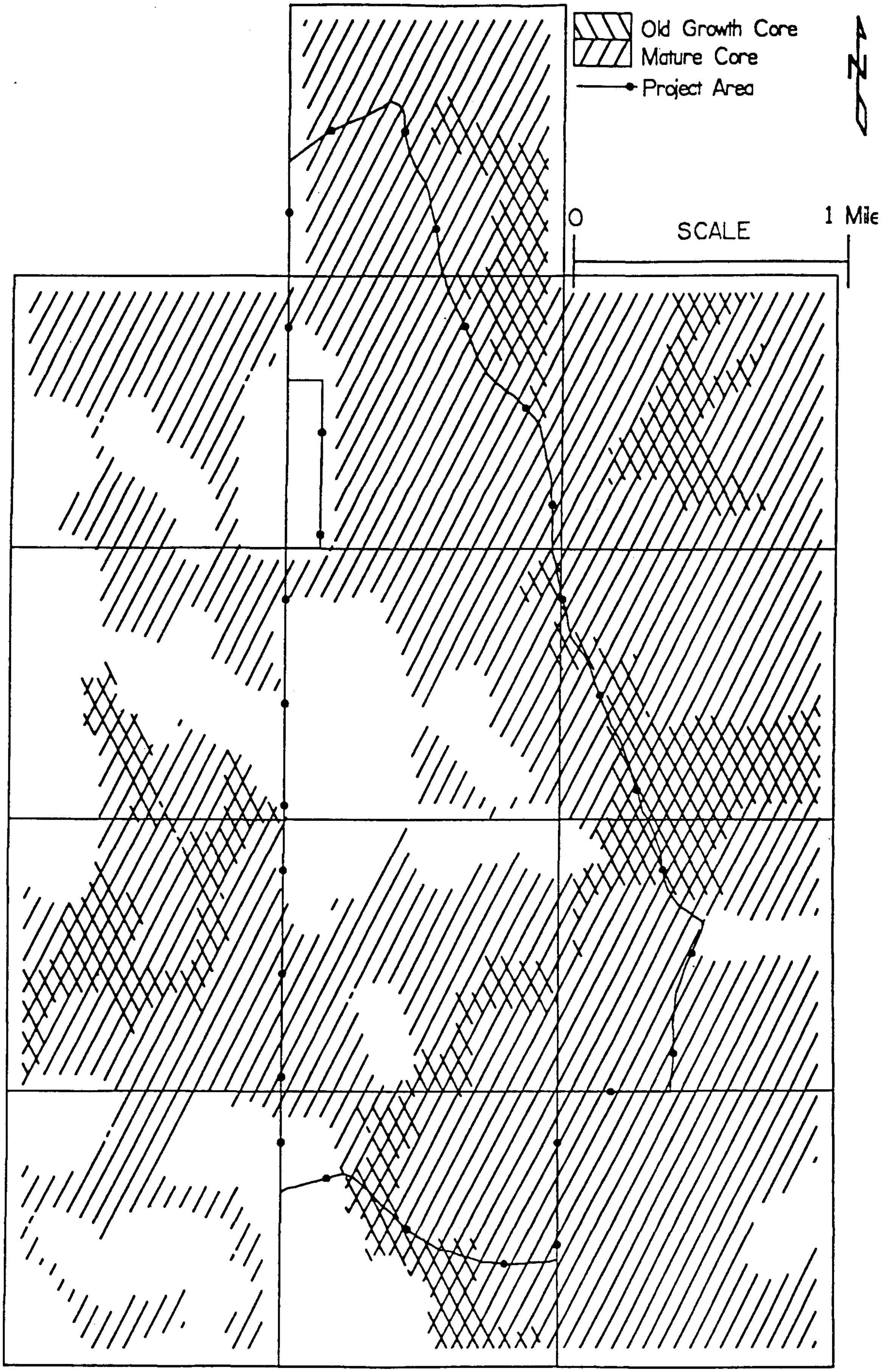
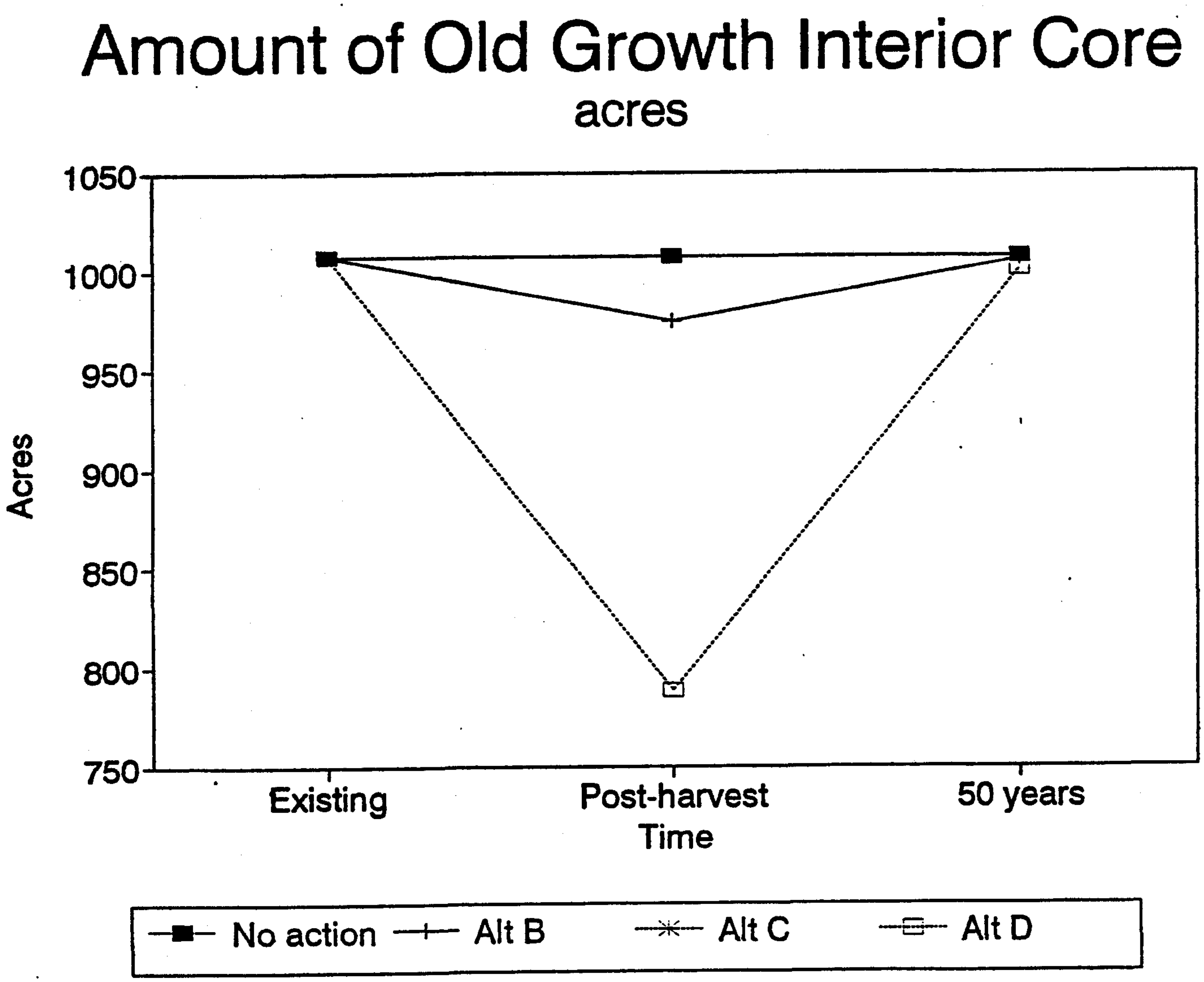

Amount of Mature Interior Core
acres
6000
5500
5000
4500
4000
3500
3000
2500
2000
1500
Acres
Existing
Post-harvest
50 years
Time
No action
Alt B
Alt C
Alt D

FIGURE 4.15



YEAR 50 NO ACTION ALTERNATIVE

FIGURE 4.14


Amount of Old Growth Interior Core
acres
1050
1000
950
900
850
800
750
Acres
Existing
Post-harvest
50 years
Time
No action
Alt B
Alt C
Alt D

downed trees in the mature forest stands. These developments must be seen as part of the normal process of ecosystem succession in the forests of the ESAA. In fully natural forests, however, periodic disturbance, most often fire, limited the duration and areal extent of the forests that ensue from succession, and created the mosaic and diversity of habitats that were historically present in the area. It seems certain that fire will not be allowed to assume its historical role in ecosystem processes within the ESAA or any of the SRSF, so no action would eventually lead to establishment of a forest with much reduced diversity, spatial variety, and structural complexity than in the past.

Structural enhancement harvests planned under Alternative B should improve structural complexity in the existing old-growth. The addition of small gaps and reduction in numbers of shade tolerant tree species should allow for some regeneration of canopy species that will increase tree diversity and spatial heterogeneity within the stands. With care taken to retain existing snags and downed logs, structural complexity would also be preserved. This should contribute to prolonged structural diversity in the affected stands.

Under Alternative C, stand diversity within the largest mature block would decrease specifically by setting unit C2 (Figure 2.3) back to a multistoried age stand more consistent with the stand lying directly adjacent to its northern boundary.

Alternative D would serve to increase the structural diversity of many stands, in particular those of units D1, D2, D8, D9, D10, and D11 (Figure 2.4) with respect to areas bordering each unit. This however would have an overall negative affect since this diversity would come at the expense of increased fragmentation immediately post-harvest. Furthermore, the treatment proposed for unit D10 would adversely affect its role as a component of a core area for this relatively large existing old growth stand.

E. Summary

In the short term for Alternative A, fragmentation would decrease, and total area of mature forest would increase. In the long term, however, fragmentation would increase again, old-growth would decrease, and the mixed conifer forest that now exists would be replaced by a less diverse and structurally less complex Douglas-fir dominated ecosystem.

Under Alternative B, lengthening the persistence of existing old-growth, increasing the total acreage of mature forest, improving structure and diversity within existing forest habitats, and reducing fragmentation would all promote the existence of the forest ecosystem within the ESAA for the long term (>50 years). Indeed the net expansion of mature forest acreage should be viewed as a step toward restoration of the ecosystem. Repeated application of harvesting plans similar to the one proposed under Alternative B could, over the long term, reverse the losses in old-growth that have been occurring in SRSF and ultimately re-establish ratios of disturbed to intact forest to near historical levels.

Alternative C does not address the basic tenets of ecosystem sustainability in the long term. Under this alternative the ESAA would still retain the high degree of fragmentation which currently exists immediately post-harvest. Additionally, one of the most important, larger mature stands within it (unit C2) would be significantly altered. The treatment to be applied to unit C2 (Figure 2.3) under Alternative C would remove any usefulness that it would have as a core area for the largest, unfragmented mature stand in the ESAA. In fact application of regeneration harvesting with heavy reserve would set this existing core area back 50 to 100 years and alter the heart of this larger mature stand for the foreseeable future. The treatment proposed for unit C1 would place this acreage back to the sapling stage and greatly increase fragmentation in this area. At 50 years post harvest, many of the elements of ecosystem sustainability would have improved, however juxtaposition of contrasting patch types would recover much more slowly than under the other alternatives. Thus, though the existing mature forest would be largely retained in its current state under Alternative C, such benefits to ecosystem sustainability would be counter-balanced by the much slower movement toward historical conditions of patch shape and juxtaposition than the other alternatives.

Though many of the units slated for harvest in Alternative D are similar to those effected in Alternative B, the degree to which they would be harvested is significantly greater. Over the short term significant affects would be observed both in loss of mature stands as well as in overall increased fragmentation. These would be specifically manifested as the entire loss of small pieces of existing old growth (units D1 and D2) (Figure 2.4), the increased fragmentation that would occur within one of the largest existing blocks of old growth (units D10 and D11), and the additional loss of a primary core area within this same old growth block. Over the longer term (50 years) some of these affects would still be felt. For example, mean patch size, although much larger than currently, would be smaller than the under the other alternatives, and shapes of immature stands would remain excessively regular. Given 50 years free of disturbance, however, other elements of ecosystem sustainability (e.g., amount of old growth, existence of interior core) are projected to become similar to those under the other alternatives.

II. ENVIRONMENTAL EFFECTS OF THE FOUR ALTERNATIVES ON OLD-GROWTH PRESERVATION

The analysis of old growth is based on the 2591-acre project area; however, changes in the amounts of existing old growth are also given for SRSF and Soup and Cilly Creek watersheds. The methods used to analyze the old-growth preservation major resource concern were described in Chapter III. The environmental effects of the four alternatives on old-growth preservation are described below and summarized in Figure 4.15.

A. Effects of Alternative A on Old-growth Preservation

1. Discussion of effects

Old growth exists on 1,309.2 acres, representing 50.5 percent of the project area. Old-growth vigor classes and corresponding acreage are as follows: good-to-fair vigor, 357.9 acres; fair-to-poor vigor, 576.7 acres; and very poor vigor, 374.7 acres (Table 3.9) (Montana Dept. of State Lands 1991-1994).

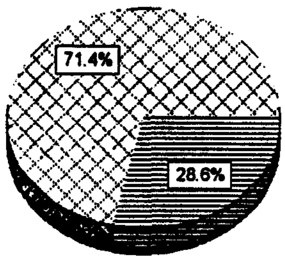
Old-growth stands having good-to-fair or fair-to-poor vigor would probably remain relatively stable for a number of decades. Scattered trees would periodically die, maintaining the presence of snags and large down logs--important ecological attributes of old growth. A diversity of large, shade-intolerant species would continue to codominate old-growth stands. Shade-tolerant species, however, would continue to encroach upon shade-intolerant species, increasing stand densities and decreasing species diversity.

Old-growth stands having very poor vigor would decline due to natural processes over the next several decades. Large, shade-intolerant trees such as western larch, ponderosa pine, lodgepole pine (*Pinus contorta*), western white pine, and Douglas-fir would be weakened or killed by mountain pine beetle, Douglas-fir beetle, dwarf mistletoe, root diseases, white pine blister rust, or other insects and diseases that currently exist in project area stands. Shade-tolerant species such as Engelmann spruce, subalpine fir, and grand fir would begin to dominate stands as they encroached on shade-intolerant species. The diminished species diversity and reduced abundance of large trees would no longer qualify the stands as old growth.

Slow rates of natural decomposition due to the cool, moist climate in the project area would maintain an abundance of large snags and down logs in stands for many decades. Large accumulations of dead, woody material combined with unnaturally high stand

Figure 4.15 *Effects of the Alternatives on Old Growth Preservation*

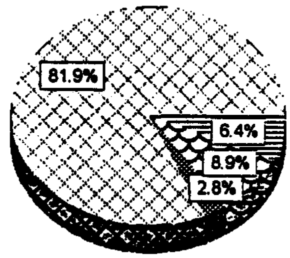
Alternative A



- Relatively Stable (934.6 Acres)
- Threatened by Natural Processes (374.7 Acres)

Existing Old Growth (1,309.3 Acres)

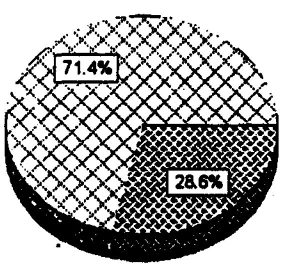
Alternative B



- Relatively Stable (1,072.6 Acres)
- OG Eliminated for 200 years (32.0 Acres)
- OG Eliminated for 50 years (117.3 Acres)
- Threatened by Natural Processes (83.4 Acres)

Old Growth Preserved (1,155.9 Acres)

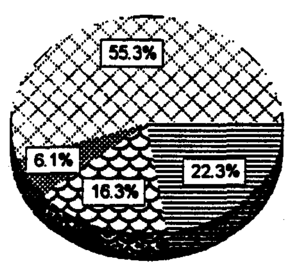
Alternative C



- Relatively Stable (934.6 Acres)
- Threatened by Natural Processes (374.7 Acres

Old Growth Preserved (1,309.3 Acres)

Alternative D



- Relatively Stable (724.5 Acres)
- OG Eliminated for 200 Years (79.4 Acres)
- OG Eliminated for 50 Years (213.6 Acres)
- Threatened by Natural Processes (291.8 Acres

Old Growth Preserved (1,016.3 Acres)

Old Growth Preserved = Relatively Stable Old Growth + Threatened Old Growth densities and increasing ladder fuels from shade-tolerant species would increase the risk of severe, stand-replacing fire. Stand replacing fire would place existing old-growth stands at risk.

2. Summary of effects

Although the no-action alternative would preserve existing old growth for the short term, it would not promote long-term old-growth preservation (Figure 4.15). Old-growth stands would begin to break up as shade-intolerant trees in them died off. The surrounding, even-aged stands would be too small and too young to effectively replace old growth. Mortality of large, shade-intolerant species in old-growth stands would hasten the dominance of shade-tolerant species having ladder fuels. Increased fuel loads may contribute to stand-replacing fire and subsequent destruction of old growth.

B. Effects of Alternative B on Old-growth Preservation

1. Discussion of effects

Under Alternative B, three different silvicultural treatments would be applied to stands containing old growth and each would have different effects on old-growth preservation. Effects of the three treatments are discussed below.

a. moderate-reserve, regeneration harvesting

Moderate-reserve, regeneration harvesting would be applied to cutting units B1 and B2 (Figure 2.2) which contain a total of 44.3 acres. Thirty-six of those 44.3 acres are currently classified as old growth. The 36 acres represent 2.7 percent of the existing old growth in the project area.

Moderate-reserve treatment would retain some important structural and compositional characteristics of old growth in treated stands by leaving eight, large, overstory trees per acre; scattered clumps of healthy understory trees; and fifteen to twenty tons of large, woody debris. Although some old-growth characteristics within stands would be retained, the 36 acres would no longer meet the requirements for old-growth classification. It would probably take 200 years--barring further major disturbance--before the treated stands would once again possess old-growth characteristics.

b. heavy-reserve, regeneration harvesting

Heavy-reserve, regeneration harvesting would be applied to cutting units B3 through B7 which contain a combined acreage of 129.2 (Figure 2.2). These units contain 117.3 acres of old growth representing 9.0 percent of the existing old growth in the project area.

Heavy-reserve treatment would reduce basal area to 80 square feet per acre, retaining approximately 30 large trees per acre along with scattered clumps of healthy understory and 15 to 20 tons of large, down woody material. The 117.3 acres would not meet the requirements for old growth classification. Without further major disturbance, the treated stands would probably attain old-growth status within 50 years[1].

c. structural enhancement

Structural enhancement would be applied to cutting units B8 through B18 which contain a total of 832.7 acres (Figure 2.2). These units contain 775.1 acres of old growth representing 59.2 percent of the old growth in the project area.

The structural enhancement treatment would employ commercial thinning techniques to reduce competition from encroaching shade-tolerant species and prolong the presence of large, shade-intolerant trees. Stand densities would be reduced by 10 percent. Structural enhancement would not reduce the existing acreage of old growth. Old-growth stands with very poor vigor would be improved to the fair-to-poor vigor class which would also improve the relative stability of these stands.

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[1]Within 50 years, trees that were released by the treatment would have grown, creating multistoried stands and effectively closing the stand canopies. The numbers of large trees per acre, the numbers of large down logs, and the canopy covers in the stands would all meet the criteria for old-growth classification.

2. Summary of effects

a. effects immediately post-harvest

Under Alternative B, 36.0 percent of the area encompassed by SRSF would be classified as old growth--a decrease of 0.4 percent from the existing 36.4 percent. In Soup Creek and Cilly Creek watersheds, 47.6 percent of the area encompassed by the watersheds would remain as old growth--a slight decrease from the existing 48.9 percent.

b. short- and long-term effects

Under Alternative B, 81.9 percent of existing old growth in the project area would remain relatively stable for several decades; 6.4 percent would remain very unstable and at risk of losing its old-growth status within several decades; 8.9 percent would lose old-growth status for 50 years; and 2.8 percent would lose old-growth status for 200 years (Figure 4.15). Alternative B would reduce the total amount of old growth on the project area from 1,309.3 acres to 1,155.9 acres. The treatments, however, would increase the amount of old growth that would remain relatively stable from 934.6 acres (71.4 percent) to 1,072.6 acres (81.9 percent) and reduce the amount of old growth that is likely to break up within several decades from 374.7 acres (28.6 percent) to 83.4 acres (6.4 percent).

C. Effects of Alternative C on Old-growth Preservation

1. Discussion of effects

Under Alternative C, no old-growth stands would be treated; all existing old growth would be preserved. As with Alternative A, 28.6 percent of the existing old growth would remain in very poor vigor. Old growth having very poor vigor would be threatened by natural processes and preserved for the short term only.

Although no old growth would be harvested, some edge effects may degrade the quality of existing old growth in stands adjacent to cutting units. In cutting unit C1 (Figure 2.3), moderate-reserve, regeneration harvesting would be applied to a stand in the multistoried stand class. Approximately three MBF per acre, or three to six trees per acre, would be removed; therefore, effects on existing edge would be minimal. In cutting unit C2, heavy-reserve, regeneration harvesting would retain approximately 80 square feet of basal area per acre and 70 percent crown cover. Edge effects of this treatment would also be minimal.

2. Summary of effects

The short- and long-term effects of Alternative C on old-growth preservation would be nearly the same as Alternative A, the no-action alternative (Figure 4.15).

D. Effects of Alternative D on Old-growth Preservation

1. Discussion of effects

Under Alternative D, three different silvicultural treatments would be applied to stands containing old growth and each would have different effects on old-growth preservation. The effects of these treatments on old growth are discussed below.

a. light-reserve, regeneration harvesting

Light-reserve, regeneration harvesting would be applied to cutting units D1 and D2 which contain 11.2 acres (Figure 2.4). All 11.2 acres are classified as old growth; they represent 0.9 percent of the old growth in the project area.

Light-reserve treatment would change the stand class of the 11.2 acres to grass/seedling/shrub. It would likely take 200 years without further major disturbance before the area would achieve old-growth status again.

b. moderate-reserve, regeneration harvesting

Moderate-reserve, regeneration harvesting would be applied to cutting units D3 through D7 which contain a total of 88.3 acres (Figure 2.4). Of those 88.3 acres, 68.1 are classified as old growth; they represent 5.2 percent of the old growth in the project area.

For the same reasons given under Alternative B, moderate-reserve treatment would change the stand class of the 68.1 acres of old growth to grass/seedling/shrub. The amount of old-growth in the project area would be reduced by 5.2 percent. Without further major disturbance, old-growth conditions would likely be restored within 200 years.

c. heavy-reserve, regeneration harvesting

Heavy-reserve, regeneration harvesting would be applied to cutting units D8 through D11 which contain a total of 224.2 acres (Figure 2.4). This acreage includes 212.5 acres of old growth representing 16.2 percent of the existing old growth in the project area.

For the same reasons given under Alternative B, heavy-reserve treatment would change the stand class of the 212.5 acres of old growth to saw timber. The amount of old growth in the project area would be reduced by 16.2 percent. Without further major disturbance, old-growth conditions would likely be restored within 50 years [1].

2. Summary of effects

a. effects immediately post-harvest

Under Alternative D, 35.7 percent of the area encompassed by SRSF would be classified as old growth--a decrease of 0.7 percent from the existing 36.4 percent. In Soup Creek and Cilly Creek watersheds, 46.4 percent of the area encompassed by the watersheds would remain as old growth--a small decrease from the existing 48.9 percent.

b. short- and long-term effects

Under Alternative D, 55.3 percent of existing old growth would remain relatively stable for the next several decades; 22.3 percent would remain at risk of losing old-growth status within several decades; 16.3 percent would lose old-growth status for 50 years; and 6.1 percent would lose old-growth status for 200 years (Figure 4.15). The total amount of old-growth in the project area would be reduced from 1,309.3 acres to 1,016.3 acres, a reduction of 22.4 percent.

III. EFFECTS OF THE ALTERNATIVE ON TIMBER PRODUCTIVITY

The methods used to analyze the timber productivity major resource concern are described in Chapter III. The effects of the alternatives on timber productivity are described below.

Alternative A reflects the existing timber productivity for the project area. Under Alternative A, stands in the project area would remain at an average vigor value of 2.50. Under Alternative B, the average vigor would improve to 2.36. Under Alternative C, vigor in the project area would improve only slightly to 2.49. The average vigor under Alternative D would improve to 2.39. Although Alternative D would generate the greatest increase in timber productivity on the treated acres, it does not treat as many acres as Alternative B. Alternative B, while not increasing productivity as efficiently as Alternative D, does achieve the best overall improvement in timber productivity.

A. Effects of Alternative A on Timber Productivity

1. Discussion of effects

Under the Alternative A no timber would be harvested. Natural processes would proceed uninterrupted by timber harvesting.

a. negative productivity

Stands with very poor vigor occur on 18.2 percent (471.3 acres) of the project area. Stands having very poor vigor probably have negative productivity; that is, tree mortality in the stands probably exceeds growth.

Negative productivity would probably continue for several decades until shade-tolerant species replaced shade-intolerant species. After several decades, growth and mortality would begin to balance, but average timber volumes per acre would remain relatively low.

b. zero productivity

Stands with fair-to-poor vigor occur on 28.1 percent (728.5 acres) of the project area. Growth and mortality nearly balance in these stands, and timber productivity is close to zero.

Relatively high rates of mortality are occurring within stands having fair-to-poor vigor due to old age and natural processes such as insect infestation, disease, blowdown, or fire. If no action were taken, these stands would probably begin to exhibit very poor vigor and negative growth within the next several decades.

c. positive productivity

Stands with good-to-fair vigor occur on 39.5 percent (1,024.1 acres) of the project. Stands having good-to-fair vigor probably have positive growth; that is, tree growth probably exceeds tree mortality but falls far short of yield capability.

If no action were taken, stands having good-to-fair vigor would probably continue to exhibit positive growth for the next several decades or longer.

d. full productivity

Stands with full vigor occur on 14.2 percent (367.1 acres) of the project area. These stands are relatively young and include the young pole, sapling, and grass/seedling/shrub stand classes. Growth is occurring at near optimal rates. The continued health and productivity of these stands are jeopardized by exposure to insects and disease from adjacent older stands

2. Summary of effects

If the no-action alternative were selected, no timber would be harvested from the project area, and natural processes would not be interrupted. Timber productivity would likely continue to decline on 46.3 percent (1,199.8) of the project area having very poor or fair-to-poor vigor. Moderate increases in yield would continue within 39.5 percent (1,024.1 acres) of the project area having good-to-fair vigor. Only fourteen percent (367.1 acres) of the project area would approach optimal timber productivity. Most trees that died would become too decayed to be merchantable through future salvage harvesting. Future timber productivity would be further compromised by adjacent insect-infested and diseased stands.

B. Effects of Alternative B on Timber Productivity

1. Discussion of effects

a. moderate-reserve, regeneration harvesting

Moderate-reserve, regeneration harvesting would be applied to cutting units B1 and B2 containing 44.3 acres that are currently in either good-to-fair or fair-to-poor vigor. Within five years, regeneration would have established and all of the 44.3 acres would convert to full vigor with growth near full potential. Treated old-growth and saw-timber stands would no longer expose adjacent young stands to risk of infection by dwarf mistletoe.

b. heavy-reserve, regeneration harvesting

Heavy-reserve, regeneration harvesting would be applied to cutting units B3 through B7 containing 129.2 acres (Figure 2.2). This treatment would convert 14.2 acres from fair-to-poor vigor to good-to-fair vigor. It would also convert 103 acres having very poor vigor to a vigor class of fair to poor. Timber productivity on these 103 acres would increase from negative productivity to zero productivity. The risk of adjacent, young stands becoming infected by dwarf mistletoe would be somewhat reduced on the 129.2 treated acres. Within 20 years, the residual overstory would begin to suppress growth of regeneration, reducing future timber productivity.

c. structural enhancement

Structural enhancement would be applied to 832.7 acres within cutting units B8 through B18 (Figure 2.2) This treatment would have little effect on stand vigor within most treated stands. The vigor on 188.2 acres of old growth having very poor vigor would be improved to the fair-to-poor vigor class. The vigor and timber productivity on the remaining 644.5 treated acres would not change. The risk of adjacent, young stands becoming infected by dwarf mistletoe would not change.

2. Summary of effects

Alternative B would increase timber productivity (Figure 4.16). Under Alternative B, stands having full vigor would increase from 367.1 acres to 411.5 acres, or 15.9 percent of the project area. Very little change would occur in areas with good-to-fair vigor. Stands having good-to-fair vigor would decrease from 1,024.1 acres to 1,019.4 acres, or 39.3 percent of the project area. Stands having fair-to-poor vigor would increase from 728.5 acres to 980.0 acres, or 37.8 percent of the project area. The reduction of stands with negative productivity would represent the most substantial change in timber productivity. Stands having very poor vigor and negative productivity would decrease from 471.3 acres to 180.1 acres. The average vigor for the project area would improve from 2.50 to 2.36. The overall risk of young stands becoming infected by dwarf mistletoe would be somewhat reduced on 129.2 acres and substantially reduced on 44.3 acres.

C. Effects of Alternative C on Timber Productivity

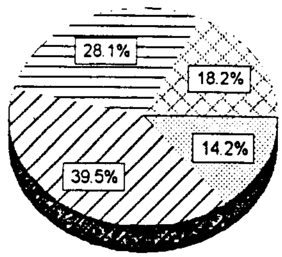
1. Discussion of effects

a. moderate-reserve, regeneration harvesting

Moderate-reserve, regeneration harvesting would be applied to a 12.9-acre stand in the multistoried stand class (cutting unit C1) having fair-to-poor vigor (Figure 2.3). Removing the existing overstory would release the established sapling understory and increase the vigor of the stands to full vigor. The risk of the sapling understory and adjacent, young stands becoming infected by dwarf mistletoe would be substantially reduced.

Figure 4.16 *Effects of Alternatives on Timber Productivity*

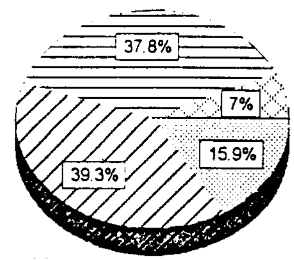
Alternative A



- Very Poor (471.3 acres)
- Fair to Poor (728.5 acres)
- Good to Fair (1,024.1 acres)
- Full Vigor (367.1 acres)

Average vigor value for the project area: 2.50

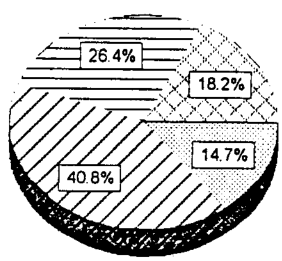
Alternative B



- Very Poor (180.1 acres)
- Fair to Poor (980.0 acres)
- Good to Fair (1,019.4 acres)
- Full Vigor (411.5 acres)

Average vigor value for the project area: 2.36

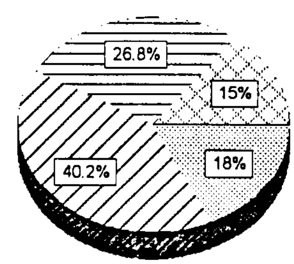
Alternative C



- Very Poor (471.3 acres)
- Fair to Poor (683.0 acres)
- Good to Fair (1,056.7 acres)
- Full Vigor (380.0 acres)

Average vigor value for the project area: 2.49

Alternative D



- Very Poor (388.5 acres)
- Fair to Poor (694.5 acres)
- Good to Fair (104.3 acres)
- Full Vigor (466.7 acres)

Average vigor value for the project area: 2.39

These percentages are based on the 2,591 acres in the project area.

Vigor values and classes are as follows:

vigor value	*vigor class*	*timber productivity*
4.00	*Very Poor*	*:Negative productivity, mortality exceeds growth.*
3.00	*Fair to Poor*	*:Zero productivity, mortality balances with growth.*
2.00	*Good to Fair*	*:Positive productivity, growth exceeds mortality but far short of yield potential.*
1.00	*Full Vigor*	*:Positive productivity, yield near potential.*

b. heavy-reserve, regeneration harvesting
Heavy-reserve, regeneration harvesting would be applied to a 49.6-acre saw-timber stand (cutting unit C2). This treatment would not change the timber productivity on 17.0 acres that are currently in the good-to-fair vigor class. On 32.6 acres, timber productivity would be improved from a vigor class of fair to poor to a vigor class of good to fair. Heavy-reserve treatment would not reduce the risk of young stands becoming infected with dwarf mistletoe because there are no young stands adjacent to cutting unit C2 (Figures 2.3, 3.1).

2. Summary of effects
Under Alternative C only 62.5 acres would be treated. The vigor of 45.5 acres would be increased. The vigor of 17.0 acres would be unchanged. The number of acres in the project area having full vigor would increase from 367.1 acres to 380.0 acres (Figure 4.16), a slight increase of 0.8 percent. The area having good-to-fair vigor would increase to 1,056.7 acres, or 40.8 percent of the project area. The area having fair-to-poor vigor would decrease to 683.0 acres, or 26.4 percent. The area having very poor vigor would remain unchanged by this alternative. The risk of young stands becoming infected with dwarf mistletoe would be substantially reduced on only 12.9 acres.

D. Effects of Alternative D on Timber Productivity

1. Discussion of effects

a. light-reserve, regeneration harvesting
Light-reserve, regeneration harvesting would be applied to cutting units D1 and D2 which contain 11.2 acres (Figure 2.4). The treatment would be applied to 6.4 acres currently having very poor vigor and 4.8 acres having fair-to-poor vigor. Within five years, regeneration would establish and all 11.2 acres would have full vigor. The risk of adjacent young stands becoming infected with dwarf mistletoe would be substantially reduced.

b. moderate-reserve, regeneration harvesting
Moderate-reserve, regeneration harvesting would be applied to cutting units D3 through D7 which contain 88.3 acres (Figure 2.4). The treatment would be applied to 30.8 acres with good-to-fair vigor, 37.7 acres with fair-to-poor vigor, and 11.9 acres with very poor vigor. Within five years after treatment, all 88.3 acres would

have full vigor. The risk of adjacent young stands becoming infected with dwarf mistletoe would be substantially reduced.

c. heavy-reserve, regeneration harvesting

Heavy-reserve, regeneration harvesting would be applied to cutting units D8 through D11 which contain 225.4 acres (Figure 2.4). The treatment would convert 56.5 acres from very poor vigor to fair-to-poor vigor and 48.0 acres from fair-to-poor vigor to good-to-fair vigor. This treatment would not change 120.9 acres that already have good-to-fair vigor. The risk of adjacent young stands becoming infected with dwarf mistletoe would be somewhat reduced.

2. Summary of effects

Under Alternative D, 325.0 acres would be treated. The combination of treatments in this alternative would generate the largest number of acres having full vigor. Eighteen percent of the project area, or 466.7 acres, would be converted to the full vigor class (Figure 4.16). The portion of the project area having good-to-fair vigor would increase from 39.5 percent (1024.1 acres) to 40.2 percent (1041.3 acres). The number of acres having fair-to-poor vigor would be reduced to 694.5, or 26.8 percent. The area having very poor vigor would be reduced to 388.5, or 15 percent. The average vigor for the project area would be 2.39-- just slightly lower timber productivity than Alternative B. The risk of adjacent, young stands becoming infected by dwarf mistletoe would be substantially reduced on 99.5 acres and somewhat reduced on 224.3 acres.

IV. THE ENVIRONMENTAL EFFECTS OF THE PROJECT ON OTHER RESOURCE CONCERNS

A. Grizzly Bear

As described in Chapter III, the effects of each alternative were assessed by their effects on motorized access, the amount and distribution of security habitat, hiding cover, and seasonal habitats. The analysis area was the South Fork Lost Soup Subunit in the Bunker Creek Bear Management Unit.

Data on motorized access and hiding cover were provided by the DNRC Inventory Division, Missoula. Habitat value maps were provided by the Flathead National Forest, Kalispell. Open Road Densities (ORD), Total Road Densities (TRD), amount and distribution of security habitat, and seasonal habitats were calculated with the EPPL7 Geographic Information System.

1. Motorized access

None of the alternatives involve new road construction. For all alternatives the TRD would remain at 43 percent for the entire subunit and 52 percent for DNRC land within the subunit. Open Road Densities would be affected differently by the various alternatives.

a. Alternative A

Under alternative A, the status of roads in the subunit would remain the same as the existing condition. The open road density would remain 34 percent for the entire subunit and 43 percent for DNRC land within the subunit.

b. Alternatives B, C, and D

Under the action alternatives, approximately 1.8 miles of the upper Soup Creek Canyon Road and 1.6 miles of the upper Cilly Ridge Road would be gated. This would change their status from open to restricted. The ORD would be reduced to 28 percent for the subunit and 34 percent for DNRC land within the subunit.

2. Security habitat

Reclaimed roads and restricted roads that effectively preclude motorized access are allowed in security areas (Interagency Grizzly Bear Committee 1994). None of the alternatives reclaim any existing roads or make currently restricted roads less passable to motorized vehicles. For all alternatives, security habitat would remain at 38 percent of the subunit.

3. Hiding cover

Hiding cover for grizzly bears would be affected differently by each alternative. Areas receiving light- or moderate-reserve, regeneration harvesting would lose their hiding cover for approximately 15 years. Areas treated with heavy-reserve, regeneration harvesting or structural enhancement would retain hiding cover for grizzly bears.

a. Alternative A
Under Alternative A, hiding cover would not be diminished.

b. Alternatives B, C, and D
The area by which each action alternative would reduce hiding cover in the subunit immediately post-harvest is as follows: Alternative B - 44.3 acres, Alternative C - 12.9 acres, and Alternative D - 99.5 acres. None of these reductions would numerically reduce the hiding cover of the subunit below the existing 79 percent. Neither would they numerically reduce the hiding cover of DNRC land within the subunit below the existing 91 percent. DNRC guidelines (Montana Dept. of Natural Resources and Conservation 1995) recommend retaining a minimum of forty percent of a subunit in hiding cover.

4. Seasonal habitats
Habitats in the NCDE have been classified into three categories based on their probability of use by grizzly bears: use less than expected, use equals expected, and use greater than expected (Manley 1992); habitats used "greater than expected" are presumed to be preferred by grizzly bears. Habitat values have been described for five seasons (Chapter III).

Areas receiving light- and moderate-reserve treatment are assumed to convert to the "use less than expected" category. Areas receiving heavy-reserve treatment and structural enhancement retain their existing values. There is no assumption that harvest-related activities improve grizzly bear habitat.

Currently, there is no provision for projecting habitat values into the future to account for plant succession. Therefore, habitat values reflect conditions immediately post-harvest.

a. Alternatives A, B, and C
For all five seasons, the percentages of the subunit in any of the three "probability of use" categories is the same as those listed in Table

3.12. Since none of the project area meets security habitat criteria, habitat values within security areas would not be affected.

b. Alternative D

For Alternative D, habitat classified as "use greater than expected" would decline from 19 percent to 18 percent for the early spring season. For the remaining four seasons, habitat values would remain the same as described in Chapter III. Habitat values within security areas would not be affected.

Riparian areas are used extensively by grizzly bears (Interagency Grizzly Bear Committee 1987). Under alternatives B and D, two stands adjacent to wetlands would receive moderate-reserve, regeneration harvesting: stands B1 (=D6) and B2 (=D7). Visual screening would be retained along all interfaces between wetlands and cutting units.

c. mitigation common to all alternatives

To avoid displacement of bears, all action alternatives would limit timber harvesting activities to the denning season, November 16 through March 15.

B. Elk

Impacts to elk habitat were analyzed for each alternative using the method described in Chapter III. Post-harvest habitat values of stands treated with each of the silvicultural treatments would be as follows: Stands treated with light- and moderate-reserve, regeneration harvesting would no longer provide hiding or thermal cover, but would provide forage. Stands treated with heavy-reserve, regeneration harvesting would be patchy and numbers of trees per acre post-harvest will vary. An average crown cover of about 70% would be retained, which would provide elk summer thermal cover and hiding cover. Areas so treated would provide some scattered forage post-harvest, but for analysis it was assumed they would not provide forage. Stands treated with structural enhancement would not change substantially with regard to elk habitat value. Hiding and thermal cover would be provided, but forage would not.

1. open roads

No roads would be constructed under any alternative, and all action alternatives would utilize existing roads to access timber. Open road density in the analysis area would remain at 1.2 miles of open road per square mile. The analysis assumes that elk avoid areas near roads that are heavily used by humans, and it considers these areas unavailable as potential elk habitat. Due to road effects, 55 percent of the area would remain available as potential elk habitat under all alternatives.

2. hiding and thermal cover

Areas receiving light- and moderate-reserve treatments would no longer provide hiding or thermal cover. The number of acres in treatments 1 and 2 and the percentages of the analysis area that would provide hiding and thermal cover post-harvest are listed below by alternative.

TABLE 4.1 ***Elk Hiding and Thermal Cover in the Analysis Area***

Alternatives	Acres upon which cover would be reduced[1]	Percent of analysis area that would provide **thermal** cover	Percent of analysis area that would provide **hiding** cover
A	0	61.2	90.9
B	44.3	60.4	90.1
C	12.9	61.0	90.7
D	99.6	59.5	89.2
MFWP recommenation: greater than 15 percent of the analysis area should provide thermal cover and greater than 40 percent should provide hiding cover.			

[1]Acres receiving light- or moderate-reserve, regeneration harvesting

3. forage areas

Areas receiving silvicultural light- and moderate-reserve treatment would provide forage post-harvest. Acreage are given in Table 4.2. The total percentages of the analysis area that would provide forage post-harvest, by alternative, are as follows: Alternative A, 26.2%; Alternative B, 26.9%; Alternative C, 26.4; and Alternative D, 27.9%. The recommendation is that at least 30 percent of the analysis area provide forage. None of the alternatives meet this recommendation, although Alternative D comes closest. Forage would be evenly distributed across the landscape, present in all quadrants for all alternatives.

Elk prefer to forage in areas with cover nearby and the recommendation is that at least 90 percent of the forage areas be within 500 feet of cover. Most of the current and proposed forage areas in the analysis area are fairly small, and 99 percent of all forage areas would be within 500 feet of cover for all alternatives. Adequate cover between forage areas is also important, and recommendations are that cover between at least 75 percent of the openings should be at least 800 feet in width. Because there is less than 800 feet of cover between most of the forage areas in the analysis area for all the alternatives (alternatives A, 22%; B, 30%; C, 29%; and D, 28%), potential elk habitat was reduced by 10 percent for all alternatives. The action alternatives are closer to the recommendation than the no-action alternative because some of the cutting units are strips between existing openings. Alternative B comes closest to meeting this recommendation.

Table 4.2 ***Elk Forage in the Analysis Area***

Alternative	Acres upon which forage would be increased[1]	Percent of Analysis Area that would provide forage	MFWP Recommendation
A	0	26.2	≥ 30 % of analysis area
B	44.3	26.9	≥ 30 % of analysis area
C	12.9	26.4	≥ 30 % of analysis area
D	99.6	27.9	≥ 30 % of analysis area

[1]Acres receiving light- or moderate-reserve, regeneration harvesting

4. security areas

The recommendation is that at least 20 percent of an analysis area provide security, and that at least 60 percent of the security area provide cover (Leege 1984). All alternatives would meet this recommendation. Because no new roads would be constructed, the percentage of the analysis area that provides security would not change from the current 26.7 percent under any action alternative. Alternatives A and C would retain all cover within the secure areas at 78 percent, and alternatives B and D would both reduce cover in secure areas from the current 78 percent to 77 percent.

5. summary of effects

Overall elk habitat potential was reduced by 50 percent for all alternatives due to open road density, inadequate forage areas, and inadequate cover between openings. None of the action alternatives would differ from the no-action alternative with regard to elk habitat potential.

C. White-Tailed Deer

The analysis area provides high-quality summer and fall habitat for white-tailed deer. Recommendations from MFWP for managing summer habitat (Cross 1983) are that about 50 percent of the upland habitat be maintained as summer thermal cover, about 25 percent be maintained as hiding cover, about 25 percent be maintained as foraging areas.

Hiding cover, forage, and thermal cover values would be the same as those given in the elk analysis (Tables 4.1, 4.2). Hiding cover is currently provided on at least 90.9 percent of the analysis area and would be reduced to no less than 89.2 percent by any action alternative. Foraging areas are currently available on 26.2 percent of the analysis area. Forage areas would not change under Alternative A, and would increase to 26.9 percent under Alternative B, to 26.4 percent under Alternative C, and to 27.9 percent under Alternative D. Summer thermal cover is currently provided on at least 61 percent of the analysis area, and would be reduced to 60.4 percent under Alternative B; 61.2 under Alternative C; and 59.5 percent under Alternative D. All alternatives would maintain hiding cover, thermal cover, and forage areas well within the MFWP recommended thresholds.

Additional MFWP recommendations for management of vegetation around riparian areas would be followed under all alternatives (Appendix D). To avoid retaining deer in the project area past the time when they should migrate to winter range, logging would be deferred until December 15 or until snow depth exceeds 18 inches.

D. Gray Wolves

Wolves are not known to currently inhabit the Swan Valley. Managing habitat for wolves primarily entails maintaining an adequate prey base (in northwest Montana, white-tailed deer and elk) and preventing illegal, human-caused wolf mortality.

White-tailed deer and elk habitat (foraging area and hiding/thermal cover) will be retained above MFWP recommended minimums for all alternatives.

No new roads are proposed by any alternative; road densities will remain at 1.2 miles per square mile in the analysis area.

All action alternatives would limit logging activity to the winter season. By this time, pups of the year would be traveling with adults in the pack so there would be no disturbance to den or rendezvous sites.

F. Sensitive Animal Species

1. western big-eared bat

Impacts from the proposed project on western-big eared bats are limited to the harvest of potential daytime roost sites: snags and live mature tree snag recruits. The analysis for cavity-nesting species will address snags and snag recruits.

2. fisher

Timber harvesting can affect fishers by reducing the total amount of late-successional forest, by selectively harvesting individual large mature trees, and by fragmenting late-successional forest by creating more open areas which fishers are reluctant to cross. The analysis for ecosystem sustainability will address total amount and connectivity of late-successional forest, and the analysis for cavity nesters will address availability of large overstory trees and snags.

Fishers are also very vulnerable to trapping pressure and are easily caught in sets for bobcats, coyotes, and other furbearers. Density of roads that can be traveled by snowmobile, and trapping pressure should not change due to the project (see Lynx). Vulnerability to trapping may increase with Alternative D, due to a reduction in late-successional habitat and a potential increase in home range size; this impact is not expected with alternatives A, B, and C.

3. lynx

Timber harvesting can affect lynx through habitat fragmentation and alteration of forest successional stages. Proportions of forest in different successional stages, forest fragmentation, and travel corridors will be addressed under the analysis for ecosystem sustainability.

Timber harvesting can also affect lynx through road building and consequent increased human access and trapping pressure. Lynx with large home ranges are particularly vulnerable. No new roads would be constructed in the project area and about 3.4 miles of road would be closed with gates in the Grizzly Bear BMU (see grizzly bear analysis). However, because most trappers travel by snowmobile and can go around gates, trapping pressure should not increase or decrease.

4. black-backed woodpeckers

Humans impact black-backed woodpeckers primarily through fire suppression, and harvesting trees that are heavily infested with insects. Fire suppression is outside the scope of the proposed project and none of the alternatives proposes to harvest partially burned trees. The analysis for ecosystem sustainability addresses forest processes, of which insect infestations are a natural part. The analysis for cavity nesters addresses availability of snags and decaying trees suitable for nesting.

5. bog lemmings

Logging activities can affect bog lemmings by: (1) changing the hydrology of an area, and (2) building roads immediately up-slope of a sphagnum bog inhabited by bog lemmings. Timber harvesting activities prescribed by all action alternatives of the project would have very minimal impacts on the hydrology of the area (see water quality analysis), and water levels in bogs should not measurably change(Tony Nelson, DNRC hydrologist, personal communication). No new roads would be constructed in any action alternative that would negatively affect bog lemming habitat.

G. Cavity-Dependent Species

1. Effects of silvicultural treatments

a. light and moderate-reserve, regeneration harvesting
Areas treated with light-reserve, regeneration harvesting would provide very minimal habitat for cavity-dependent wildlife post-harvest. Efforts would be made to retain all existing snags, broken boles not capable of spreading disease, and two large trees per acre. This would provide habitat for species that prefer very open habitat, such as bluebirds and American kestrels. Habitat for these species, however, is not generally limiting. Areas treated with moderate-reserve, regeneration harvesting would also only provide habitat for species preferring open areas, though more trees would be retained and habitat would be of somewhat greater value. Both treatments would open up areas enough so that snags would be easily visible. Snags in cutting units that are near open roads could thus be harvested by firewood cutters, and some snags retained for wildlife probably would not persist far into the future. All the existing nonmerchantable large downed wood would remain post-harvest, and some additional downed wood would be left if necessary so that a total of 15 to 20 tons per acre would remain post-harvest. Much of this downed wood, however, would not be the large intact trees and logs which are of greatest value to wildlife and which would exist after a natural disturbance, but would be unmerchantable long butts and cull logs. This downed wood would provide some feeding opportunities for some bird species, but areas would be too open immediately post-harvest to receive more than minimal use by most small mammals. As shrubs and small trees grow and provide additional overhead cover, areas so treated should receive increased use by small mammals.

b. heavy reserve, regeneration harvesting
Areas treated with heavy-reserve, regeneration harvesting would remove 20 to 60 percent of the trees. Efforts would be made to retain all existing snags, broken boles not capable of spreading disease, and dead trees not infested with bark beetles. This treatment would open up areas enough so that some snags would be easily visible. Snags in cutting units that are

near open roads could thus be harvested by firewood cutters, and some snags retained for wildlife probably would not persist far into the future. Because snags would be less visible in this treatment than in the previous two treatments, snags would be less vulnerable to firewood cutters. All the existing nonmerchantable downed wood would remain post-harvest, and some additional downed wood would be left if necessary so that a total of 15 to 20 tons per acre would remain post-harvest. Much of this downed wood, however, would not be the large, intact trees and logs which are of greatest value and which would exist after a natural disturbance, but would be unmerchantable long butts and cull logs. Downed wood density should increase immediately post-harvest, although there will be fewer large, high-quality, downed-wood recruits with removal of 20 to 60 percent of the mature trees. Areas so treated should provide nesting and feeding habitat for most species of cavity-dependent wildlife that naturally occur in this forest type. Habitat quality, however, would be lower because fewer nesting and feeding sites would be available and areas so treated would probably support fewer individuals. Impacts would vary with the age of the trees: in younger stands that are of presently low value to cavity nesters, this treatment would allow some trees to attain larger sizes and the overall effect may be neutral or even positive in the long run. In older stands where the trees are already of high value, impacts would be negative. Some species that prefer denser canopy cover may find more heavily harvested patches within such cutting units suboptimal or not usable. Predation by corvids and owls on songbirds and woodpeckers would probably increase in these areas. Adequate canopy cover and downed wood should remain to provide at least minimal habitat for most species of small mammals.

c. structural enhancement

Habitat quality in areas treated with structural enhancement should not diminish due to the treatment immediately post-harvest, and post-harvest habitat quality may improve in the long run. Many of the trees that would be harvested with this treatment are the shade-tolerant true firs and Douglas-fir which are not highly preferred by cavity-nesting species. Thinning the stand should reduce competition and stress in the shade-intolerant species, larch and ponderosa pine in particular, and promote increased vigor and growth in these species that are preferred by cavity-nesting species. Some trees would probably attain larger sizes at maturity, which would create larger snags and eventually larger downed logs. Because size is an important attribute of snags and mature trees to cavity-nesting species, these trees would be of potentially greater value. All existing downed wood would remain in place. Timber harvesting would not target large mature trees and should not affect high quality downed woody recruits.

2. Effects of alternatives

a. alternative a

Habitat quality for cavity-nesting species should remain high. Natural successional and disturbance processes would continue to take place, creating snags as trees die and downed wood as trees fall. Some snags near open roads may be cut by firewood cutters.

b. alternative b

Habitat quality would be reduced substantially for most species of cavity nesters over about 48 acres; only the few species of cavity nesters that prefer open habitat would be able to use these areas. Trees in these 48 acres are of moderate value to cavity nesters, based on size and age of the trees. Because these 48 acres are not adjacent to open roads, snags in the units should not be vulnerable to removal by firewood cutters. Habitat quality would also be reduced, but to a much lesser degree, over about 140 acres. Most species would still be able to nest and feed in these 140 acres, but probably fewer individuals of each species, and predation would probably increase. Over 897 acres, habitat quality should not change immediately post-harvest, and should improve in the long run.

c. alternative c

Over about 12 acres, most of the existing trees would be harvested. This area, however, was harvested in the past and at present only provides habitat for those species preferring open habitat. Because these 12 acres are not adjacent to open roads, snags in the units should not be vulnerable to removal by firewood cutters. Habitat quality may be reduced in the short term, and possibly improved in the long term, over an additional 49 acres. Trees in this stand are fairly young and small, and a partial harvest may benefit the remaining trees. Many species would still be able to nest and feed in these 49 acres, but probably fewer individuals of each species, and predation would probably increase.

d. alternative d

Habitat quality would be reduced substantially for most species of cavity nesters over about 107 acres. Only the few species of cavity nesters that prefer open habitat would be able to use these areas. About 25 of these acres are presently of very high value to cavity nesters, based on the large size of the trees, stand age, and species composition. The other 82 acres are of moderate to high value to cavity nesters. About 20 of these acres have open roads going through them and many of the snags retained for wildlife would be vulnerable to removal by firewood cutters. Habitat quality would also be reduced, but to a much lesser degree, over about 239 acres. Most species would still be able to nest and feed in these 239 acres, but probably fewer individuals of each species, and predation would probably increase. Open roads are adjacent or go through some of these areas and snags within about 200 feet of the road would be more vulnerable to removal by firewood cutters.

e. summary

Alternative A should retain high habitat quality for cavity-nesting species in the short and long-term. Alternative B would have minimal to negligible negative impacts to cavity-nesting species, and may in the long run have a net positive impact. Alternative C would have moderate negative impacts in some areas and probably some positive impact over a large area in the long run. Alternative D would have substantial negative impacts in some areas and moderate negative impacts in other areas.

H. Water Quality

1. Sedimentation

Sediment delivery to streams (sedimentation) is a key factor affecting water quality. The main sources of introduced sedimentation are road construction and road use. Timber harvesting activities--especially in riparian areas--may also increase sedimentation by reducing the filtering capability of vegetation.

For every action alternative, timber harvesting would comply with BMP's. Timber would not be harvested from SMZ's. The recommendations of a hydrologist and a soil scientist would be incorporated into all timber harvesting activities. No new roads would be constructed.

a. effects of Alternative A on sedimentation
Alternative A would not directly affect sedimentation in the Soup Creek and Cilly Creek watersheds. Under Alternative A, no new roads would be constructed and no timber would be harvested in the Soup Creek or Cilly Creek watersheds as a result of the Middle Soup Creek Project.

Alternative A may indirectly affect sedimentation in the Soup Creek and Cilly Creek watersheds. Under Alternative A, no stream crossing replacements or road improvements would be made. These sediment source sites would depend upon natural processes for recovery unless funding for improvements became available.

b. effects of Alternative B on sedimentation
Under Alternative B, risk of sedimentation would increase mainly from timber harvesting activities. Risk would be minimized due to operation on frozen and/or snow-covered conditions. These impacts would be short-term, decreasing as vegetation established on bare soil and BMP's took effect.

Implementing Alternative B would result in a net reduction of sedimentation in the Soup Creek and Cilly Creek watersheds. Improperly designed stream crossings would be replaced to eliminate existing sediment sources. Additional drainage features and a gate restricting motorized traffic would be installed on approximately 1.8 miles of Soup Creek Canyon Road. Approximately 1.7 miles of Upper Cilly Ridge Road would be closed to motorized traffic with a permanent gate (southwest quarter of section 10). These activities may create short-term increases in sediment and turbidity by exposing bare soil during operation, but they would lead to a net, long-term benefit to water quality by stabilizing current erosion sources and revegetating bare soil.

c. effects of Alternative C on sedimentation

Alternative C would increase the risk of sedimentation in Cilly Creek Watershed mainly through timber harvesting activities. No new roads would be constructed in Soup Creek or Cilly Creek, and no timber harvesting would occur in Soup Creek Watershed. The risk of sedimentation would be minimized due to operation on frozen and/or snow-covered conditions. These impacts would be short-term, decreasing as vegetation established on bare soil and BMP's took effect.

Implementing Alternative C would also result in a net reduction of sedimentation in the Soup Creek and Cilly Creek watersheds. Improperly designed stream crossings would be replaced to eliminate existing sediment sources. Additional drainage features and a gate restricting motorized traffic would be installed on approximately 1.8 miles of Soup Creek Canyon Road. Approximately 1.7 miles of Upper Cilly Ridge Road would be closed to motorized traffic with a permanent gate (southwest quarter of section 10). These activities may create short-term increases in sediment and turbidity by exposing bare soil during operation, but they would lead to a net, long-term benefit to water quality by stabilizing current erosion sources and revegetating bare soil.

d. effect of Alternative D on sedimentation

Under Alternative D, risk of sedimentation would increase mainly from timber harvesting activities. The risk would be minimized due to operation on frozen and/or snow-covered conditions. These impacts would be short-term, decreasing as vegetation established on bare soil and BMP's took effect.

Like Alternatives B and C, Alternative D would result in a net reduction of sedimentation in the Soup Creek and Cilly Creek watersheds. Improperly designed stream crossings would be replaced to eliminate existing sediment sources. Additional drainage features and a gate restricting motorized traffic would be installed on approximately 1.8 miles of Soup Creek Canyon Road. Approximately 1.7 miles of Upper Cilly Ridge Road would be closed to motorized traffic with a permanent gate (southwest quarter of section 10). These activities may create short-term increases in sediment and turbidity by exposing bare soil during operation, but they would lead to a net, long-term benefit to water quality by stabilizing current erosion sources and revegetating bare soil.

2. Water yield

The WATSED model uses the equivalent clearcut area (ECA) method to estimate the increase in water yield caused by removing live trees. Modeled results are best used to evaluate alternatives that include different amounts and locations of cutting units and roads, and various mitigation measures. Tables 4.3 and 4.4 summarize the effects of each alternative on equivalent clearcut area and water yield in Soup Creek and Cilly Creek watersheds.

Table 4.3 ***Comparison of Modeled Watershed Effects By Alternative for Soup Creek***

Alternatives	Acres Harvested	ECA Generated	Total ECA[1]	Percent Increase in Annual Run-off[1]	Percent Increase in Annual Sediment[2]
A	0	0	567	1	18
B	634	50	617	1	27
C	0	0	567	1	18
D	284	107	674	1	27

1 Values are based on projection year 1997, following harvest
2 Values are based on projection year 1998, following site preparation

a. effects of Alternative A on water yield

Alternative A would not affect water yield. ECA levels for water yield would remain at or near present levels and would eventually decrease as previously harvested stands regenerated and moved closer to predisturbance levels of water use and snowpack distribution (Tables 4.3, 4.4).

b. effects of Alternative B on water yield

Alternative B would generate very little ECA relative to the number of acres harvested. In Soup Creek Watershed, Alternative B would treat 634 acres and generate approximately 50 ECA (Table 4.3). In Cilly Creek Watershed, Alternative B would treat 372 acres and generate approximately three ECA (Table 4.4).

Table 4.4 ***Comparison of Modeled Watershed Effects by Alternative for Cilly Creek***

Alternatives	Acres Harvested	ECA Generated	Total ECA[1]	Percent Increase in Annual Runoff[1]	Percent Increase in Annual Sediment[2]
A	0	0	474	3	44
B	372	3	477	3	44
C	63	17	491	3	35
D	40	9	483	3	44

1 Values are based on projection year 1997, following harvest
2 Values are based on projection year 1998, following site preparation

Alternative B would generate very little ECA when compared to acres harvested because 833 of the proposed 1006 harvest acres would be treated with structural enhancement. No ECA would be generated by this treatment because only ten percent of basal area per acre would be harvested. Research indicates that soil moisture and snowpack are not affected when ten percent or less basal area per acre is removed (Troendle 1989).

c. effects of Alternative C on water yield
Alternative C would treat 63 acres in Cilly Creek Watershed and generate approximately 18 ECA (Table 4.4). The water yield of Cilly Creek would increase by about one percent over existing conditions.

Alternative C would not treat any stands in Soup Creek Watershed.

d. effects of Alternative D on water yield
Alternative D would treat about 284 acres in Soup Creek Watershed and generate approximately 107 ECA (Table 4.3). In Cilly Creek Watershed, Alternative D would treat about 40 acres and generate approximately nine ECA (Table 4.4). For Soup Creek Watershed, the total ECA level would be 581, and for Cilly Creek Watershed, that figure would be 394. These values are well below the ECA threshold for each watershed.

3. Modeled sediment yield

The WATSED model allows relative comparisons of sediment yields resulting from different amounts and locations of road construction and timber harvest. The results of sediment modeling are best used to compare alternatives rather than using the estimates as absolute values.

a. effects of Alternative A on sediment yield

None of the proposed stream crossing rehabilitations, road improvements or road closures would be completed with this sale. Modeled sediment yields would remain at or near present levels (Tables 4.3 and 4.4), relying on natural or preexisting conditions for recovery until other sources of funding become available to repair them.

b. effects of alternative b on sediment yield

Alternative B would generate some increase in modeled sediment yield following residue treatment in 1998 in Soup Creek Watershed. These increases would last for approximately one year before returning to pre-harvest levels. In the Cilly Creek watershed, modeled sediment yield would also increase following harvest and residue disposal, but would return to pre-harvest levels in about six years. Much of the sediment increases in Alternative B would be offset by the closure of Cilly Ridge Road and Soup Creek Canyon Road. There would also be decreases in sediment yield due to the repair and stabilization of numerous point sources of sediment. These decreases are not accounted for or reflected in WATSED results.

c. effects of alternative c on sediment yield

Modeled results of Alternative C show no measurable change in sediment yield in the Soup Creek watershed, and a net decrease for the Cilly Creek watershed. Sediment yield in Soup Creek Watershed would decrease from the existing condition due to the closure of Soup Creek Canyon Road, rehabilitation of existing point sources of sediment, and no proposed timber harvest, but the change is too small to be reflected in model results. Cilly Creek would have a net decrease in modeled sediment yield because of the closure of Cilly Ridge Road, low levels of harvest, and helicopter yarding.

d. effects of alternative d on sediment yield

Alternative D would produce a net decrease in modeled sediment yield in the Cilly Creek watershed. Closure of Cilly Ridge Road would lead to a decrease in sediment yield. Following residue treatment, model results would return to pre-activity levels for about five years and would then drop back to levels lower than existing ones. In the Soup Creek watershed, modeled sediment yields would increase over existing levels for approximately two years, then return to pre-harvest levels. There would also be decreases in sediment yield not reflected in model results due to the repair and stabilization of numerous point sources of sediment. These decreases cannot be accounted for in WATSED.

4. Summary of effects

There is little risk of adverse cumulative effects to water quality resulting from any of the proposed action alternatives provided BMP's, the SMZ law, and the recommendations of DNRC hydrologists and soil scientists are followed. No harvesting would occur within the SMZ and no new roads would be constructed. All action alternatives are well within water yield thresholds. All action alternatives would result in a net reduction in sedimentation in Cilly and Soup Creek watersheds.

I. Fisheries

SMZ's containing bull trout streams would not receive treatment under any alternative. Fisheries monitoring would continue annually through the duration of the project and for one year after project completion under all three action alternatives but not under the no-action alternative. Under the action alternatives, stream rehabilitations and road improvements as described under "Sedimentation" would be completed. Eliminating sources of sedimentation may lead to improved fisheries.

2. Effects of Alternatives

a. effects of Alternative A on fish habitat

The fisheries habitat condition would remain essentially unchanged under Alternative A. Erosion sources would not be remedied under the No Action Alternative. Monitoring of fisheries habitat by DNRC would be discontinued for Soup Creek until future projects presented the need for additional data.

b. effects of action alternatives on fish habitat
In keeping with "Immediate Actions for Bull Trout" recommended by the Governor's bull trout restoration team, none of the action alternatives propose harvesting timber in an SMZ (Montana Dept. of Natural Resources and Conservation 1994). Cutting unit boundaries have been proposed well away from SMZ boundaries in all action alternatives. All action alternatives would close Soup Creek Canyon Road and install erosion control and drainage features over approximately 1.8 miles. Cilly Ridge Road would also be closed to motorized traffic with each action alternative. In addition, several existing sediment sources and improperly installed stream crossing structures would be replaced. These activities would lead to a short-term increase in sedimentation during construction. As the sites revegetate and stabilize there would likely be a long-term benefit to fish habitat by the elimination of long-term and chronic sources of sediment.

3. Summary of effects
Fisheries monitoring would continue annually through the duration of the project and for at least one year after project completion under all action alternatives.

All proposed harvest activities would present a low risk of impact to fisheries habitat or populations because BMP's; the SMZ law; Immediate Actions for Bull Trout Restoration; and Flathead Basin Forest Practices, Water Quality and Fisheries Program recommendations would be followed. No harvesting would occur in the SMZ and no new roads would be constructed. The project may benefit fish habitat because the recommendations of a fisheries biologist and hydrologist would be followed under all action alternatives. All action alternatives would result in a net reduction of sedimentation in Soup and Cilly Creeks when rehabilitation measures (outlined in the Water Quality section, pages IV 51, 52) are implemented.

I. Air Quality
After timber harvesting, cutting units are burned to reduce logging residue such as nonmerchantable treetops and limbs. Burning logging residue decreases the risk of wildfire by reducing fuel loading. It also prepares sites for tree regeneration. Burning is usually conducted during late summer or early fall when weather conditions and fuel moisture levels are optimal to meet burning objectives. During burning periods, smoke may temporarily reduce air quality in the vicinity of the project area..

1. Effects of silvicultural treatments on air quality

Light- and moderate-reserve treatments would generate the most fuel loading and have the greatest potential impact to air quality.

Structural enhancement would not affect air quality because no burning would be required. The small amount of logging residue created by structural enhancement treatment would not substantially increase fuel loadings. For this treatment, logging residue would be hand-lopped and scattered.

2. Effects of the alternatives on air quality

a. Alternative a

Alternative A would not directly affect air quality. No timber harvesting and no burning would occur.

b. Alternatives b, c, and d

Alternative C would have the smallest effect on air quality. Under Alternative C, excavator piling and burning would occur on 62.5 acres. Alternative B would treat more total acres than Alternative D, but only 173.5 acres, 17 percent of the total acreage, would require excavator piling and burning. Alternative D would treat 323.7 acres and 100 percent of those would require excavator piling. Alternative D would have the greatest effect on air quality. Impacts on air quality would be short-term; smoke would linger for a few days.

J. Soil

Timber harvesting activities may rut, compact, or displace soil. Such soil impacts may contribute to poor regeneration, reduced site productivity, and erosion. Soil susceptibility to impact varies with soil types, harvest methods, equipment, and season of activity (Figure 3.6, Table 3.18). The effects of each alternative on soil are described here and summarized in Table 4.5.

Table 4.5 ***Soil Effects by Alternative***

Alternatives	Acres Harvested	Acres Harvested by Tractor on Snow	Acres Trafficked by Skid Trails [1]	Acres of Site Prep.	Acres of Soil Impacted [2]	Percent of Cutting Unit Impacted
A	0	0	0	0	0	0
B	1006.2	1006.2	127	17	21	2
C	62.5	12.9	3	63	3	5
D	323.7	323.7	65	107	22	7

[1] 15-20% of cutting units
[2] 7.5-10% of skid trails and <15% of excavator-piled area

1. Effects of Alternative A on soil
Alternative A would not directly affect the soil in the project area.

Alternative A may indirectly lead to soil erosion in the project area. Although the existing primary, secondary, and spur roads are currently in good condition, they would not be maintained under Alternative A, and they would begin to erode. Increased erosion may lead to increased sedimentation, a soil-related process that is addressed under "Water Quality."

2. Effects of Alternatives B and D on soil
Alternative B has the greatest potential impact on soil. Under alternatives B and D, skidding would be conducted on 1006.2 acres and 323.7 acres, respectively. Skidding could negatively effect 17.5 to 20 percent of each cutting unit. Of that 17.5 to 20 percent, 7.5 to 10 percent would be severely impacted, and 10 percent would be moderately impacted. Excavator piling could also impact soil.

Several precautions would be taken to reduce soil impacts due to skidding and excavator piling. Harvesting would be conducted in the winter on snow-covered, frozen soil. Skid trail systems would be planned in advance, and existing trails would be used where available. Track-hoe excavators, rather than brush dozers, would be used; track-hoe excavators have more flexibility and impact soil less than brush dozers. Excavator piling and soil scarification would be limited to less than 40 percent of the cutting units. Trails would not be constructed on more than 20 percent of each cutting unit. Woody debris would be retained to promote long term soil stability and productivity.

3. Effects of Alternative C on soil

Alternative C would have little effect on soil in the project area because it employs helicopter logging. Ground skidding would occur on about 12.9 acres and excavator piling would occur on about 62.5 acres. All of the same precautions that would be taken under alternatives B and D would be taken under Alternative C.

K. Noxious Weeds

Noxious weeds are less likely to invade forested sites than nonforested sites; they typically spread along open roads and on barren slopes. The effects of each alternative on the encroachment and establishment of noxious weeds are discussed.

1. Effects of Alternative A on noxious weeds

The no-action alternative would not directly affect the encroachment and establishment of noxious weeds. Alternative A would do nothing to reduce the existing noxious weeds in the project area; spotted knapweed (*Centaurea maculosa*) and common St. Johnswort (*Hypericum perforatum*) would continue to spread along open roads and disturbed areas where vegetation has not established.

2. Effects of the action alternatives on noxious weeds

All action alternatives strive to prevent the encroachment of noxious weeds and to control established populations along open roads by using an integrated weed management approach that includes prevention, control, and prompt revegetation.

To prevent further encroachment of noxious weeds, all equipment would be cleaned of weeds and mud prior to entering the site. Disturbed roadsides and landings would be revegetated with site-adapted grasses. To provide for rapid grass establishment, a special "quick cover mix" of slender wheatgrass (*Agropyron trachycaulum*) or annual ryegrass (*Lolium temulentum*) would be sown concurrently with disturbance. To provide a more permanent cover, a mixture of hard fescue (*Festuca ovinaduriascula*), tall fescue (*Festuca arundinacea*), slender wheatgrass, and redtop (*Agrostis alba*) would be sown concurrent with road construction.

Where noxious weeds occur along Goat Creek Loop Road, Soup Creek Road, Soup Creek Campground, and Cilly Creek Loop Road, a one-time application of herbicide followed by grass seeding would attempt to control established populations. Approximately 2.9 acres per mile of road would be treated, totaling 42.5 acres along 14.6 miles of road.

Biocontrol agents and physical treatments would not be used. Biocontrol agents do not work well in the strip-shaped weed populations that exist in the project area along roads. Physical treatments such as surface blading reduce the dispersal of seed, but they do not control weeds on road cuts or fill slopes.
For this project, herbicide treatment is considered the most effective means to control existing noxious weeds, promote grass and native vegetation and reduce the spread of noxious weeds. Herbicide application would be site specific to locations where weeds occur.

The herbicide treatment would use a combination of picloram, commonly known by the tradename Tordon ®, and 2,4-D (Amine 4 ®). The herbicides would be applied at the doses recommended on their labels. Picloram would be applied at about two quarts per acre (0.12 gallons per acre of active ingredient); 2,4-D would be applied at three pints per acre (0.18 gallons per acre of active ingredient).

3. About the herbicides
Picloram is a restricted herbicide (It can only be used by certified applicators) that acts on broadleaf plants as a growth regulator. Picloram persists in soil due to its slow degradation by soil microorganisms and ultraviolet light. Because of its persistence, picloram would provide an effective two- to three-year control of spotted knapweed and common St. Johnswort, allowing native vegetation to re-establish.

2,4,-D is not a restricted herbicide and is used in products marketed for home use. It acts on broadleaf plants as a growth regulator. 2,4,-D does not persist; soil microorganisms break it down in a matter of weeks. Because it breaks down, 2,4-D is safer to use near surface water, but it is less effective than picloram.

4. Effects of the herbicides on humans and wildlife
Human health risks associated with herbicides used for noxious weed control have been documented by the U.S. Forest Service (Monning 1986). The Forest Service report

concluded that, even considering mixing errors and a variety of accident scenarios (i.e. spills, leaks), the "no-observable-effects levels" for human health are not exceeded.

Picloram and 2,4,-D are specifically analyzed for human toxicology in a USDA Forest Service EIS (1989) (USDA Forest Service 1989). The EIS summarized studies that show these herbicides do not bioaccumulate. Animals high on the food chain (humans, eagles, wolves) are not expected to acquire concentrated doses of these chemicals by feeding on contaminated plants or animals.

Using picloram and 2,4,-D may reduce forage availability. Knapweed and St. Johnswort are considered unpalatable to wildlife, but they may provide some forage. Seeding following herbicide application is designed to replace weeds with more palatable grasses and control erosion, allowing native plants to establish over the long term. Established grasses would not be affected because the herbicides act on broadleaf plants only.

Wildlife could receive doses of herbicide by eating contaminated food either through direct consumption of herbicide-treated vegetation or indirect consumption, such as a mountain lion feeding on elk that has consumed herbicide-treated grass. Wildlife, especially birds, may be sprayed by herbicide during application. The Forest Service EIS (USDA Forest Service 1989) discusses in-depth toxicology for wildlife species that would typically frequent treated areas. The EIS concludes that both herbicides are nontoxic if applied at recommended label doses.

Herbicide spills could put wildlife at risk. A spill could result in concentrations hundreds of times greater than concentrations occurring in treated areas. Certified applicators would be required to treat these areas as toxic waste spills. Human activity would likely preclude wildlife from entering the spill area until it is cleaned up. Impacted areas would be small and short-term.

Herbicides could impact aquatic and fisheries resources. Impacts could occur from herbicides entering streams, lakes, or wetlands via aerial drift, runoff after storms, or accidental spills. Picloram and 2,4,-D can be highly toxic to some fish and invertebrates, depending on species sensitivity and herbicide formulation. These herbicides can be toxic to some aquatic flora, and if they enter surface water, they may be detrimental to some listed sensitive plant species that occur in the project area.

5. Precautions

To reduce risk to aquatic and terrestrial resources, herbicide application would adhere to Montana BMP's and the herbicide's specific label guidelines. Herbicide application would not be general; it would be specific to areas along roads where noxious weeds occur. No herbicide would be mixed on site to reduce the risk of accidental spills. Application would occur on calm, dry days to limit aerial drift and possible surface movement off road prisms. Because of its persistence, picloram would not be applied within 50 feet of surface water. Because of its ability to break down quickly in the environment, 2,4-D would be used in areas 25 to 50 feet from surface water (Logan 1991). No herbicides would be applied within 25 feet of surface water. Neither would herbicide be applied to areas where relief may contribute runoff directly into surface water. All no-spray areas would be designated on the ground before application began. Herbicides would be applied when they are most effective: in the spring (May-June), when plants are actively growing, or in late summer (late August-September).

L. Aesthetics

None of the alternatives would affect background vistas along the western flanks of the Swan Range. The color, texture, form, and line (dominance elements) of the foreground vistas would be affected by the action alternatives. How each action alternative would affect foreground vistas depends on which silvicultural treatments the alternatives employ.

1. Visual impacts of silvicultural treatments

a. light- and moderate-reserve, regeneration harvesting

Removing trees and vegetation would create 7- to 30-acre openings in the foreground. Logging residue, cured vegetation, and exposed soil would affect the texture, color, form, and line within openings, on landings, and on skid trails.

Reserving large, mature trees (2-6 per acre) and clumps of healthy understory may feather edges and partially screen openings. Openings may appear more harsh in the winter because of the color contrast between snow and forest canopy; however, new openings may blend with the existing mosaic of openings (from past harvesting) and forest canopy.

b. heavy-reserve, regeneration harvesting

Removing trees and vegetation would create small, discontinuous openings in the foreground. The small openings made by heavy-reserve treatment would not be readily apparent, but because overstory trees would be removed in groups, skyline vistas in the foreground would become irregular. Logging residue, cured vegetation, and exposed soil would affect color, texture, form, and line within openings, on landings, and on skidtrails. Reserving some overstory and understory trees would screen most skidtrails from view.

c. structural enhancement
Structural enhancement would not substantially alter the color, texture, form, or line of foreground vistas. Logging residue, cured vegetation, and exposed soil would affect the color, texture, form, and line on log landings and skid trails. Reserving overstory and understory trees would screen most skidtrails from view.

2. Effects of each alternative
Table 4.6 gives the number of acres of each silvicultural treatment by alternative and identifies the silvicultural treatment used in each cutting unit.

a. Alternative A
If the no-action alternative were selected, the visual characteristics of the project area would not be altered by timber harvesting activities. However, the visual character of the project area would gradually be altered by time, natural disturbances, and natural processes.

b. Alternative B
Moderate-reserve, regeneration harvesting would visually affect cutting units B1 and B2 (Figure 2.2). Because these cutting units are adjacent to restricted road, the visual effects of this treatment would not be seen by the motorized public, but they would be visible to pedestrians and hikers.

Heavy-reserve, regeneration harvesting would visually affect cutting units B3 through B7 (Figure 2.2). Because these cutting units are adjacent to restricted road, the visual effects of heavy-reserve treatment would not be seen by the motorized public, but they would be visible to pedestrians and hikers.

Structural enhancement would visually affect cutting units B8 through B18. Those cutting units border open and restricted roads (Figure 2.2). The effects of structural enhancement would be visible to motorized traffic, pedestrians, and hikers.

A no-harvest buffer would be placed around the Soup Creek Campground to screen timber harvesting activities.

c. Alternative C
Moderate-reserve, regeneration harvesting would visually affect cutting unit C1. Cutting unit C1 borders restricted road (Figure 2.3). The visual effects of this treatment would not be seen by motorized traffic, but they would be visible to pedestrians and hikers.

Heavy-reserve, regeneration harvesting would visually affect cutting unit C2 (Figure 2.3). Cutting unit C2 does not border any road. The visual effects of heavy-reserve treatment would not be seen by motorized traffic or pedestrians, but they would be seen by hikers. Skidtrails would not visually affect this cutting unit because helicopters would be used for yarding.

Alternative C cutting units are located well away from the Soup Creek Campground and harvest activities are unlikely to be seen from the campground.

d. Alternative D
Light-reserve, regeneration harvesting would visually affect cutting units D1 and D2 (=B1 and B2) (Figure 2.4). These cutting units are adjacent to restricted road. The visual effects of light-reserve treatment would not be seen by motorized traffic, but they would be seen by pedestrians and hikers.

Moderate-reserve, regeneration harvesting would visually affect cutting units D3 through D7 (Figure 2.4). Cutting units D4 and D5 are adjacent to open road. Cutting units D3, D6, and D7 are adjacent to restricted road. The effects of moderate-reserve treatment would be seen by motorized traffic, pedestrians, and hikers.

Heavy-reserve, regeneration harvesting would visually affect cutting units D8 through D11 (Figure 2.4). With the exception of D11, these cutting units are adjacent to open and restricted road; the visual effects of heavy-reserve treatment would be seen by motorized traffic, pedestrians, and hikers. Cutting unit D11 borders restricted road only, so the relatively small visual effects of treatment would not be seen by motorized traffic, but they would be visible to pedestrians and hikers.

A no-harvest buffer would be placed around the Soup Creek Campground to screen timber harvesting activities.

TABLE 4.6 ***Effects of Treatments and Alternatives on Aesthetics***

Treatment & Effects	Alternative A	Alternative B	Alternative C	Alternative D
Light-reserve; Very severe effects cutting units acres	N/A	N/A	N/A	D1, D2 11.2
Moderate-reserve; Severe effects cutting units acres	N/A	B1,B2 44.3	C1 12.9	D3-D7 88.3
Heavy-reserve; Little effect cutting units acres	N/A	B3-B7 129.2	C2 49.6	D8-D11 224.2
Structural enhancement; Negligible effects cutting units acres	N/A	B8-B18 832.7	N/A	N/A

III. ECONOMIC ANALYSIS

The reasons for completing the following economic analysis are twofold: (1) to project the net monetary return from harvesting timber for each alternative; and (2) to provide a baseline for comparing net monetary return from timber harvesting with monetary return from a conservation lease.

A. Net Return Of The Alternatives

According to the projections outlined below, Alternatives A and C would have negative net returns to the school trust. Alternative D would have the highest net return, generating approximately 14 percent more revenue than Alternative B (Table 4.11).

These projections have three limitations: (1) Only known costs and benefits that are related to timber harvesting activities are considered; (2) None of the potential benefits associated with leaving trees (i.e. snag recruitment, structural diversity, aesthetics, wildlife habitat, nutrient recycling, etc.) are considered; (3) Some of the variables that affect stumpage prices (i.e. cutting unit size, harvesting season) are not isolated from more dominant variables.

1. Treatment costs of the alternatives
Table 4.7 estimates the treatment costs of each alternative. Disposing of brush by hand-lopping and scattering would cost $12.51 per acre. Brush disposal by excavator piling and site preparation would cost $92.00 per acre. Planting white pine would cost $102.35 per acre. All of these values include 15 percent for administration.

2. Gross revenue generated by the alternatives
Table 4.8 estimates the gross revenue that each alternative would generate. The volume of timber that would be harvested under each alternative was based on the SRSF Stand Level Inventory (Montana Dept. of State Lands 1991-1994). The value of timber per thousand board feet for each alternative was estimated using the current transaction evidence model. The model uses information and economic data from previous timber sales to predict the market value of timber with the roads in place. Because the model does not account for the higher costs of helicopter logging, the value per million board feet for Alternative C was reduced by $100.00.

TABLE 4.7 ***Estimated Treatment Costs by Alternative***

Alternative	Treatment	Acres	Brush Disposal and Site Prep ($/acre)	Western White Pine Planting ($/acre)	Total Cost ($)
B	Moderate-Reserve	44.3	92.00	102.35	8,609.71
	Heavy-Reserve	129.2	92.00	102.35	25,110.00
	Structural Enhancement	832.7	12.51	0	10,417.08
	Total	1,006.2			44,136.80
C	Moderate-Reserve	12.9	92.00	102.35	2,507.12
	Heavy-Reserve	49.6	92.00	102.35	9,639.76
	Total	62.5			12,146.88
D	Light-Reserve	11.2	92.00	102.35	2,176.72
	Moderate- Reserve	88.3	92.00	102.35	17,161.11
	Heavy-Reserve	224.2	92.00	102.35	43,573.27
	Total	323.7			62,911.09

TABLE 4.8 ***Estimated Total Gross Revenue by Alternative***

Alternative	Volume Harvested (MBF)	Value of Timber ($/MBF)	Total Gross Revenue ($)
A	0	0	0
B	5,177	295.65	1,530,580
C	150	-85.75	-12,863
D	5,631	300.13	1,690,032

3. Costs of MEPA, sale preparation, and administration

Table 4.9 estimates the total costs of the MEPA process (includes analysis and documentation), and sale preparation and administration for each alternative. The total estimated cost of the MEPA process was the same for each alternative, but the sale preparation and administration costs varied with the amount of timber that would be harvested. Both estimated costs were based on the Northwest Land Office's (NWLO) five-year average cost ($73.05 per MBF) for the forest products program divided by the average timber volume sold by the NWLO and other department costs prorated to the NWLO. The cost of the MEPA process was estimated at 75 percent of NWLO's average cost and was based on the volume of timber harvested under Alternative D (0.75*$73.05/MBF*5,631MBF = $308,508.41). The cost of sale preparation and administration was estimated at 25 percent of NWLO's estimated cost and varies with the volume of timber harvested under each alternative (0.25*$73.05/MBF*5,631MBF = $2,739.38). The sale preparation and administration costs were increased by ten percent for Alternative B to account for the added costs of applying structural enhancement treatment over a large area. Structural enhancement would harvest timber on a large number of acres, but a low volume of timber per acre would be harvested.

Because it was partially based on the relatively large volume of timber harvested under Alternative D, the cost of the MEPA process is a conservative estimate; that is, the estimate may be higher than the actual cost. Because it was based on the Northwest Land Office average, specific costs particular to this project may not be accounted for.

TABLE 4.9 ***Estimated Costs for MEPA Process and Documentation, Sale Preparation and Administration by Alternative***

Alternative	Volume (MBF)	NWLO Cost ($/MBF)	MEPA Cost ($)	Sale Prep & Admin Cost ($)	Total Cost ($)
A	0	73.05	308,508.41	0.00	308,508.41
B	5,177	73.05	308,508.41	132,362.95	440,871.36
C	150	73.05	308,508.41	2,739.38	311,247.79
D	5,631	73.05	308,508.41	102,836.14	411,344.55

4. Improvement costs of the alternatives

Table 4.10 estimates the total cost of in-stream rehabilitation projects, noxious weed control, and road maintenance. These costs were accounted for in the current transaction evidence model. Under Alternative A, no improvements would be made, so there is no cost.

TABLE 4.10 ***Estimated Cost for In-stream Rehabilitation Projects, Noxious Weed Control and Road Maintenance Cost by Alternative***

Alternatives	In-Stream Projects Cost ($)	Weed Control Cost ($)	Road Maintenance Cost ($)
A	0	0	0
B	28,500	3,000	11,500
C	28,500	3,000	11,500
D	28,500	3,000	11,500

5. Net revenue generated by the alternatives
Table 4.10 estimates the net revenue for each alternative. Alternatives A and C would have negative net revenue. Alternative D would generate the greatest net revenue at $1,215,776.00.

TABLE 4.11 ***Estimated Net Dollar Revenue of the Alternatives***

Alternative	Gross Revenue	Treatment Cost	MEPA Cost	Sale Prep & Admin Cost	Net Revenue
A	0	0.00	308,508.41	0	-308,508
B	1,530,580	44,136.80	308,508.41	132,362.94	1,045,572
C	-12,863	12,146.88	308,508.41	2,739.38	-336,257
D	1,690,032	62,911.09	308,508.41	102,836.13	1,215,776

B. Estimating the Value of a Conservation Lease
A conservation lease would exclude timber harvesting from the project area for twenty years. Bids for conservation leases and timber sales will be compared to determine which would generate more income for the school trust. To compare timber sale and conservation lease bids, the value of the timber that would not be harvested would be considered because that timber could be sold after 20 years. A conservation lease (CL) bid would be compared to timber sale bids as follows:

CL Bid + discounted value for same timber sale in 20 years
= total value of CL.

The discounted value of the same timber sale in twenty years would be added to the bid value for the conservation lease. The total value for the conservation lease would be compared to the highest timber sale bid, and the highest bid would win. This method of comparing bids assumes that the cost of preparing and administering a timber sale running approximately three years is the same as the cost of administering a conservation agreement over 20 years.

The discounted value of the timber sale in 20 years was estimated based on the following assumptions: (a) Stumpage values will increase at a real rate of 2.789 percent annually (Table 4.12); (b) Costs for MEPA process and documentation, and sale preparation and administration will increase at an annual rate of 3.0 percent (Table 4.13); © The real discount rate is 4.01 percent (Table 4.15); (d) Timber stands will exhibit zero net growth; and (e) There will be no opportunity cost for delaying the establishment of future stands.

TABLE 4.12 ***Estimated Total Gross Revenue by Alternative in 20 Years, Assuming a Real Increase of 2.8 percent in the Value of Timber***

Alternative	Volume Harvested MBF	Value of Timber $/MBF	Total Gross Revenue ($)
A	0	0	0
B	5,177	512.52	2,653,315
C	150	-22.85	-3,428
D	5,631	520.29	2,929,731

Table 4.13 ***Estimated Cost for MEPA and Sale Preparation and Administration In 20 Years by Alternative, Assuming a Real Increase of 3.0 Percent for MEPA Cost***

Alternatives	Volume (MBF)	NWLO Cost ($/MBF)	MEPA Cost ($)	Sale Prep & Admin Cost ($)	Total Cost ($)
A	0	131.936	557,200.50	0.00	557,200.51
B	5,177	131.936	557,200.50	239,062.21	796,262.72
C	150	131.936	557,200.50	3,369.09	560,569.60
D	5,631	131.936	557,200.50	185,733.50	742,934.01

Table 4.14 ***Estimated Future Net Dollar Revenue of Alternatives in 20 Years***

Alternative	Gross Revenue	Treatment Cost	MEPA Cost	Sale Prep & Admin Cost	Net Revenue
A	0	0.00	557,200.50	0	-557,201
B	2,653,315	44,136.80	557,200.50	239,062.21	1,812,916
C	-3,248	12,146.88	557,200.50	3,369.09	-576,144
D	2,929,731	62,911.09	557,200.50	185,733.50	2,123,886

Table 4.15 contains estimated values for a conservation lease based on the discounted values of timber sales for each alternative. The table provides examples of how conservation lease and timber sale bids would be equitably compared. If Alternative B were selected, the discounted value of the future timber sale ($825,802) would be added to the conservation lease bid for comparison with the current timber sale bid. The conservation bid would have to be at least $704,778 to be equivalent to a current total timber sale bid of $1,530,580.

Table 4.15 ***The Estimated Dollar Value for 20-Year Conservation Lease***

Alternative	Net Revenue of Timber Sale in 20 Years	Discounted Value of Timber Sale in 20 Years	Total Timber Sale Bid if Harvested Today	Estimated Value for 20-Year Conservation Lease (based on total project area)	
				total	per acre
A	-557,201	-253,810	0	N/A	N/A
B	1,812,916	825,802	1,530,580	704,778	272
C	-576,144	-271,035	-12,863	N/A	N/A
D	2,123,886	967,452	1,690,032	722,580	279

IV. IRRETRIEVABLE AND IRREVERSIBLE COMMITMENTS OF NATURAL RESOURCES

A. Irretrievable

Many stands in the project area are mature; many individual trees are more than 200 years old. If any of the action alternatives were selected, timber harvesting would occur, and some of these large, old, live trees would be irretrievably lost; they would no longer contribute to future snag recruitment, stand structural and compositional diversity, aesthetics, wildlife habitat, nutrient recycling processes or any other important ecosystem component.

B. Irreversible

The initial loss of trees due to timber harvesting would not be irreversible. Natural regeneration combined with site preparation and artificial regeneration would promote the establishment of new trees. Providing future management decisions allowed for the continued growth of established trees, the trees would ultimately become equivalent in size and age to the irretrievable, harvested trees.

V. LOCAL SHORT-TERM USES OF THE ENVIRONMENT AND LONG TERM PRODUCTIVITY

Many of the stands considered for treatment by the three action alternatives are currently declining in wood fiber value due to insect and disease, blowdown, and slow growth due to high stocking rates. For some of these stands, timber productivity has slowed to negative growth. The short-term use of harvesting timber would generate immediate income for the school trust, contribute to the local economy, and provide forest products to the marketplace. Establishing new stands of trees at or near their potential growth rates would promote long-term timber productivity.

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ABBREVIATIONS

BMP	Best Management Practices
CEA	cumulative effects analysis areas
DBH	diameter at breast height
DNRC	Montana Department of Natural Resources and Conservation
EA	Environmental Assessment
EIS	Environmental Impact Statement
ESA	Endangered Species Act
FNF	Flathead National Forest
ID team	interdisciplinary team
MBF	thousand board feet
MFWP	Montana Fish, Wildlife, and Parks Service
MMBF	million board feet
NCDE	Northern Continental Divide Ecosystem Grizzly Bear Recovery Area
OSHA	Office of Safety and Health Administration
ORD	open road density
SRSF	Swan River State Forest
TRD	total road density
USFS	United States Forest Service
USFWS	United States Fish and Wildlife Service

GLOSSARY

ACRE-FOOT
A measure of water or sediment volume, equal to an amount of material which would cover one acre to a depth of one foot.

ACTION ALTERNATIVE
One of several ways of moving toward the project objectives.

AESTHETIC
Pertaining to beauty.

AFFECTED ENVIRONMENT
Those resources (both biological and social) or components of the environment that are likely to be affected by the project.

AIRSHED
A geopgraphical area that, because of topography, meteorology, and climate, shares the same air.

BASAL AREA
A measure of the number of square feet of space occupied by the stem of a tree taken at breast height.

BEST MANAGEMENT PRACTICES
A practice or combination of practices that is determined by a state or designated area-wide planning agency to be the most effective, practicable (including technological, economic, and institutional considerations) means of preventing or reducing the amount of pollution generated by nonpoint sources to a level compatible with water quality goals.

BIOACCUMULATE
The process of a plant or animal selectively takin gin or storing a persistent substance. Over time, a higher concentration ofo the substance is found in the organism than in its environment.

BIOCONTROL AGENTS
Noxious weed control without the use of chemicals, machines, fire, or hand tools. Parasites, grazing, predators, and diseases are some of the agents used for biocontrol.

BOARD FOOT
A piece of lumber one inch thick by one foot wide by one foot long.

CANOPY
The more-or-less continuous cover of branches and foliage formed collectively by the crown of adjacent trees and other woody growth.

CAVITY
The hollow excavated in trees by birds or other animals. They are used for roosting and reproduciton by many birds and mammals.

COMPACTION
The packing together of soil particles by forces exerted at the soil surface, resulting in increased soil density.

CONNECTIVITY
1. The quality, extent, or state of being joined. 2. The opposite of fragmentation.

CORE AREA
An area of contiguous mature forest greater than (or equal to) 150 acres having 50-75 percent of its perimeter in contact with pole timber or older stands, having at least 60 percent (more desirable 80 percent) canopy cover, and containing the structural and compositional stand diversity associated with mature forest.

CORRIDOR

Mature forest corridor

A contiguous area of mature forest at least 100 meters wide, having at least 40 percent canopy cover, and connecting two or more larger areas of mature forest.

Movement corridor

A narrow but contiguous area of habitat connecting larger areas of habitat that animals use for travel. Often referred to as "dispersal " or "wildlife" corridor.

COVER
See HIDING COVER and/or THERMAL COVER.

CUTTING UNITS
Areas proposed for harvest that are composed of one or more stands of trees.

DBH CLASS
Grouping of diameters at breast height that are close to the same measurement. DBH's of 5-10 inches may constitute a dbh class.

DIAMETER PLUS SIX SPACING RULE
A tree spacing guide measured in feet that is determined by adding six to the diameter at breast height. Example: The spacing for a 10-inch diameter tree would be 16 feet. After thinning, the tree would have a 16-foot radius of treeless space around it.

DISCOUNTING
An adjustment for the value of money over time so that costs and benefits occurring in the future are reduced to a common point in time, usually the present, for comparison.

DITCH RELIEF
A method of draining water from roads using ditches and a corrugated metal pipe. The pipe is placed just under the road surface....

DOMINANCE ELEMENTS
Color, texture, form, and line are the primary elements that dominate a landscape. When changes occur within that landscape, changes also occur to these elements. The elements are defined as follows:

Color

Color (or degree of a certain color) on the landscape.

Texture

The surface characteristics, or coarseness, of objects within the landscape or overall patterns of surface characteristics on the landscape.

Form

The overall shape and structure of an object such as a tree or mountain.

Line

The direction of a major pattern within the leandscape such as tree trunks in a forest.

DRAINAGE AREA
Another word for "watershed."

ECOSYSTEM
An independent, self-sustaining community of biota.

EQUIVALENT CLEARCUT AREA (ECA)
The total area within a watershed that exists in a clearcut condition, including clearcuts, partial cuts, roads, and burns. ECA is a function of the amount of canopy removed and the size of the area harvested.

Allowable ECA

The estimated number of acres that could have canopy removed (clearcut) before stream channel stability is impacted.

Existing ECA

The number of acres that have been previously harvested taking into account the degree of hydrologic recovery that has occurred due to revegetation.

Remaining ECA

The calculated amount of harvest that may occur without substantially increasing the risk of causing detrimental effects to stream channel stability.

EXISTING CONDITION
Representation of a resource condition, level of resource output, or environmental effect that exists within a defined area.

FALL TRANSITIONAL RANGE
Forage areas used by deer as they move from the higher elevations they occupy in the summer to the lower elevations they occupy in the winter.

FORAGE
All browse and nonwoody plants available to wildlife for grazing.

FORAGE AREAS (elk)
Areas that do not qualify as cover and may or may not have shrub or tree vegetation present.

HABITAT
The place where a plant or animal naturally or normally lives and grows.

HIDING COVER (elk)
Vegetation capable of hiding 90 percent of a standing elk from view of a human at 200 feet during that period when elk normally use the area.

HIKER
For this project, an individual who traverses cross-country.

INTERDISCIPLINARY TEAM
A team of specialists, each with a particular area(s) of expertise, brought together to analyze the effects of a project on the environment.

IRRETRIEVABLE CONSEQUENCES
Consequences such as loss of timber productivity, harvesting, or use of natural resources. A stand of trees that are cut have been irretrievably lost (as opposed to irreversibly lost) because the stand can regenerate.

IRREVERSIBLE CONSEQUENCES
The extractive use of nonrenewable resources such as minerals, cultural resources, vegetation, and habitat lost to permanent roads, or in-place soil development that are renewable only over long time periods. Irreversible also includes the loss of future options.

LOG SILL BRIDGES
A bridge with abutments (sills) constructed with logs.

MERCHANTABLE
Describes trees that can be profitably converted into a salable product such as lumber.

MITIGATION MEASURE
Measure designed to make the effect of an action less severe or to compensate for negative effects.

MOTORIZED TRAFFIC
Automobiles and snowmobiles.

NO-ACTION ALTERNATIVE

The option of maintaining the status quo and continuing present management activities, deferring or not doing the proposed project.

NO-OBSERVABLE-EFFECT LEVEL
In a series of tests, the highest dose level at which no effect is observed in the animal species tested.

OLD GROWTH
1. Old growth represents the later stages of natural development of forest stands. Old-growth stands are generally understood as being dominated by relatively large old trees, containing wide variation in tree sizes, exhibiting some degree of multistoried structure, having signs of decadence such as rot and spike-topped structure, and containing standing large snags and large down logs. 2. Stand in the SRSF are identified as old-growth stands by the SRSF Stand Level Inventory if they contain at least 10 trees per acre larger than 20 inches dbh, are well-stocked, have some degree of multistoried structure, and contain decadent trees, snags, and large down logs.

OVERSTORY REMOVAL
SRSF Stand Level Inventory code that includes any stand which contains commercial-size trees in excess of 1,000 board feet per acre, and which also meets of of the following conditions (1) The trees in question are relicts (i.e. not part of the manageable stand components); (2) The trees in question represent the upper story of a two-storied stand, but they are inadequately stocked to be treated as a separate management component.

PEDESTRIAN
For this project, an individual who uses roads for walking.

POLE TIMBER

Pole-timber stands

Stands at least 16.7 percent stocked with growing stock trees of which 50 percent or more of this stocking is in pole timber and/or saw-timber trees, and with pole-timber stocking exceeding that of saw timber.

Pole-timber trees

Trees at least 5.0 inches dbh but smaller than 9.0 inches for softwoods and 11.0 inches for hardwoods.

POLYGON
1. A discrete area of mature forest within the project area that is disjunct from, but connected to, other mature forest polygons by relatively narrow corridors. 2. An ecosystem element (such as vegetation) that is relatively homogeneous internally and that differs from what surrounds it. Also called "patch."

PROJECT FILE
A public record of the analysis process, includng all documents that form the basis for the project analysis. The project file for the Middle Soup EIS is located at the Swan River State Forest office in Swan Lake, Montana.

REACH
A portion of a body of flowing water.

REDDS
The spawning nests of trout.

REGENERATION
The actual seedlings and saplings existing in a stand; or the act of establishing young trees naturally or artificially.

RESIDUE
Unused logs, uprooted stumps, broken or uprooted stems, branches, twigs, leaves, bark, and ships left on the ground after timber harvesting, storms, fire, or other disturbance.

ROAD IMPROVEMENTS
Specific construction projects along an existing road designed to improve ease of travel, safety, drainage, and water quality.

ROADS
The following kinds of roads were considered in road density estimates for grizzly bear habitat.

Administrative roads

Administrative roads provide access to administrative structures, such as the Napa Fire Lookout, or to noncorporate private property. Administrative roads are excluded from calculations of open road density and total road density.

County roads

County roads and Highway #83 are excluded from open road density and total road density calculations.

Open roads

1. Open roads pertaining to the grizzly bear analysis are roads without use restrictions. They are seasonally opened to the public during the non-denning period (3/16 - 11/15). They are administered by DNRC, Plum Creek, or the U.S. Forest Service (USFS). 2. Open roads pertaining to elk and white-tailed deer analyses are roads receiving greater than 20 vehicle trips per week.

Private roads

Roads on nonindustrial private lands. Private roads are excluded from open and total road density estimates.

Reclaimed roads

Reclaimed roads are generally impassable to motorized vehicles for most of their length. Drainage features on the road are not maintained because future use of the roads is not likely. Reclaimed roads are not included in linear mileage or road density calculations.

Restricted roads

A road administered by DNRC, USFS, or Plum Creek on which motorized use is restricted during the entire nondenning period (3/16-11/15) by a physical obstruction. Restricted roads are included in calculations of total road density.

RISK

High risk

A SRSF Stand Level Inventory code which includes the following: (1) All commercial, nonvigorous, overmature stands, as well as any merchantable stand which exhibits an unmanageable insect or disease problem; or (2) Lodgepole saw-timber stands which are over 100 years old.

Low risk

A SRSF Stand Level Inventory code which includes the following types of stands (1) All commercial stands older than 100 years which do not qualify as high risk (They are of relatively better vigor than high risk stands); (2) All commercial stands which do not qualify as high risk that are dominated by shade-tolerant species (regardless of age); (3) All commercial lodgepole stands which are 50-100 years old and nonvigorous, and which have not qualified as high risk; (4) Various other stands containing commercial material which are not manageable because of poor tree quality and vigor.

ROLL DIPS

Rolling drainage dips. A depression built into the road prism designed to prevent soil erosion by collecting and diverting water from the surface of the road.

SAPLINGS

Trees 1.0 inches to 4.0 inches in diameter at breast height.

SAW-TIMBER TREES

Softwood trees which are 9.0 inches and larger dbh.

SCARIFICATION

The mechanized manipulation of surface vegetation and litter to expose various amounts of mineral soil to enhance the establishment of natural regeneration.

SCOPE
The range of reasonable alternatives, mitigation, issues, and potential impacts to be considered in an environmental assessment or environmental impact statement.

SCOPING
The process of determining the extent of the environmental assessment task. Scoping includes public involvement to learn which issues and concerns should be addressed, and the depth of assessment that will be required. It also includes a review of other factors such as laws, policies, actions by other landowners, and jurisdictions of other agencies that may affect the extent of assessment needed.

SECURITY
The freedom from the likelihood of displacement or mortality due to human disturbance or confrontation.

SECURITY AREA (elk)
An area of at least 250 contiguous acres that is more than one-half mile from all roads having use levels of more than one vehicle per week.

SECURITY HABITAT (grizzly bears)
An area at least 2500 acres in size that is free of motorized and high-intensity, nonmotorized use of roads and trails during the nondenning period. The area is at least 0.3 miles from motorized or high-intensity, nonmotorized use roads and trails.

SEEDLINGS
Live trees less than 1.0 inch dbh.

SEDIMENT
Solid material, mineral or organic, that is in suspension and is being transported or deposited by air, water, gravity, or ice.

SEDIMENT YIELD
The amount of sediment that is carried to streams.

SERAL
A biotic community that is a developmental, transitory stage in an ecological succession.

SHADE-INTOLERANT
1. Describes tree species that reproduce and grow in the open or where the overstory is broken and allows sufficient sunlight to penetrate. 2. Seral species that get replaced by more shade-tolerant species during succession. In the Swan Valley, shade-intolerant species

generally include ponderosa pine, western larch, Douglas-fir, western white pine, and lodgepole pine.

SHADE-TOLERANT
1. Describes tree species that reproduce and grow under the canopy in poor sunlight conditions. 2. Species that replace less shade-tolerant species during succession. In the Swan Valley, shade-tolerant species generally include subalpine fir, grand fir, Engelmann spruce, and western red cedar.

SIGHT-DISTANCE
The distance at which 90 percent of a bear is hidden from view.

SILVICULTURE
The art and science of controlling the establishment, composition, and growth of forests.

SITE PREPARATION
A hand or mechanized manipulation of a site designed to enhance the success of regeneration. Treatments are intended to modify the soil, litter, and vegetation and to create microclimate conditions conducive to the establishment and growth of desired species.

SNAG
A standing dead tree.

SNOW INTERCEPT
Snow that is prevented from reaching the ground because it is caught in the forest canopy.

SPUR ROADS
Temporary roads that are constructed to meet minimum requirements for motorized traffic.

STAND
An aggregation of trees occuypying a specific area and sufficiently uniform in composition, age arrangement, and condition as to be distinguishable from the forest in adjoining areas.

STAND DENSITY
Number of trees per acre.

STOCKING
The degree of occupancy of land by trees as measured by basal area or number of trees and as compared to a stocking standard; that is, the basal area or number of trees required to fully use the growth potential of the land.

STREAM GRADIENTS
The slope of a stream along its course, usually expressed in percentage.

SUCCESSION
The process of progressive changes in plant communities.

THERMAL COVER (elk)
A stand of conifers at least 40 feet tall with an average canopy closure exceeding 70 percent.

TIMBER HARVESTING ACTIVITIES
In general, "timber harvesting activities" refers to all the activities conducted to facilitate timber removal before, during, and after the timber is removed. These activities may include any or all of the following:

- felling and bucking standing trees
- skidding logs to a landing
- processing, sorting, and loading logs at the landing
- hauling logs to a mill
- road construction
  - right-of-way clearing
  - excavation of cut/fill material
  - installation of road surface and ditch drainage features
  - installation of culverts at stream crossings
  - burning right-of-way slash
  - hauling and installation of borrow material
  - blading and shaping road surfaces
- slashing and sanitizing residual vegetation damaged during logging
- machine piling logging slash
- burning logging slash
- scarification
- planting trees

UNDERSTORY
The trees and other woody species growing under a more-or-less coninuous cover of branches and foliage formed collectively by the uper portion of adjacent trees and other woody growth.

VIGOR
The degree of health and growth of a tree or stand.

VISUAL SCREENING
The distance at which at least 90 percent of an animal is hidden from view.

WATER YIELD
The average annual runoff for a particular watershed expressed in acre-feet.

WATER YIELD INCREASE
An estimate of the percent increase in average annual runoff over natural conditions due to forest canopy removal.

YIELD CAPABILITY
The maximum mean annual increment attainable in a fully stocked natural stand expressed in cubic feet per acre per year.

MAILING LIST FOR PROJECT PROPOSAL
MAILED 9/19/94

Jane Adams)
Jeff Collins)
Pat Flowers)
Ted Giesey)
Steve Kohler)
Brian Long) Department of State Lands
Tony Nelson)
Dave Remington)
Bill Schultz)
Allen Wolf)
Alan Wood)
William Wood)

Bader, Ron, Soup Creek Ranch, Swan Lake 59911

Buentemeier, Ron, Stoltze Lumber Company, Box 1429, Columbia Falls 59912

Cluck, Al, President, Scenic Highway 83, Condon 59826

Coates, Kevin, Wildlife Biologist, Department of Fish, Wildlife & Parks, 490 N. Meridian Rd, Kalispell 59901-3854

Fairchild, Mike, 120 Derns Road, Kalispell 59901

Foresman, Kerry, Division of Biological Sciences, Health Sciences 104, University of Montana, Missoula 59812-1002

Harris, Chuck, Swan Lake Ranger District, USFS, Bigfork 59911

Henderson, Colin, Division of Biological Sciences, Health Sciences 104, University of Montana, Missoula 59812-1002

Kaufman, Nathan, President, C.A.R.E., Box 1210, Condon 59826

Martin, Mrs. Howard, Swan Lake, MT 59911

Martin, Ron, Swan Lake Rte, Bigfork, MT 59911

Montana Wilderness Association, Northwest Field Office, 216 Hemler Creek Dr., Kalispell 59901

Montgomery, Arlene, Friends of the Wild Swan, Box 103, Swan Lake 59911

Mood, Doug, Pyramid Lumber Company, Drawer J, Seeley Lake 59868

Nelson, Kathy, P.O. Box 301, Bigfork, MT 59911

Netherton, Frank, Plum Creek Timberlands, Clearwater Unit, Seeley Lake 59868

Passman, Dori, Archaeologist, Resource Development Bureau, Department of State Lands, 1625 11th Avenue, Helena 59620

Rumsey, Scott, Fisheries Biologist, Department of Fish, Wildlife & Parks, 490 N Meridian Rd, Kalispell 59901-3854

Shirey, Wayne, Box 131, Swan Lake 59911

Thweatt, Dick, Attorney, Department of State Lands, 1625 11th Avenue, Helena 59620

Wagner, Peggy, Montanans for Multiple Use, Box 68, Hungry Horse 59919

NEWS RELEASES SENT FOR PUBLICATION (9/19/94)

Bigfork Eagle, 8299 Montana Hwy 35, Bigfork 59911 837-5131 (week of Sept. 25th)

Daily Interlake, Box 8, Kalispell 59901 755-7000 (week of Sept. 18th)

Pathfinder, Box 702, Seeley Lake 59868 677-2022 (week of Sept. 29th)

ID TEAM MEMBERS

DAN ROBERSON, Forest Management Supervisor, Department of Natural Resources and Conservation (DNRC), Swan River State Forest, Swan Lake, MT 59911 **(PROJECT LEADER after January 1996)**

DANIEL C. HALL, Lead Management Forester, Swan River State Forest, Swan Lake, MT 59911 **(PROJECT LEADER until October 1995)**

DAVID L. REMINGTON, Forest Improvement Supervisor, Department of State Lands, Forestry Division, 2705 Spurgin Road, Missoula, MT 59801 **(SILVICULTURIST until spring 1995)**

DR. KERRY R. FORESMAN, Professor, Division of Biological Sciences, Health Sciences 104, University of Montana, Missoula, MT 59812-1002 **(ECOSYSTEM SUSTAINABILITY ISSUES)**

DR. COLIN B. HENDERSON, Professor, Division of Biological Sciences, Health Sciences 104, University of Montana, Missoula, Montana 59812-1002 **(ECOSYSTEM SUSTAINABILITY ISSUES)**

GLEN N. GRAY, Swan Unit Manager, Swan River State Forest, DNRC, Swan Lake, Montana 59911. **(DECISION MAKER, SILVICULTURIST after spring 1995)**

JANE S. ADAMS, Wildlife Biologist, DNRC, Northwest Land Office, Box 7098, Kalispell, Montana 59904-0098 **(WILDLIFE ISSUES)**

MIKE FAIRCHILD, Wildlife Biologist, DNRC, Northwest Land Office, Box 7098, Kalispell, Montana 59904-0098 **(GRIZZLY BEAR, GRAY WOLF ISSUES)**

APPENDIX C

Conservation Lease

August 24, 1995

LEASE OF CONSERVATION

SWAN STATE FOREST

THIS LEASE OF TIMBER CONSERVATION is made this ___________ day of ______________, 1996, State of Montana (lessor), to _______________ _________________ (lessee), whose address is_____________________.

WITNESSETH:

WHEREAS, Lessors are the sole owners in fee simple of certain real estate property in Lake County, Montana more specifically described in Exhibit A attached hereto and incorporated by this reference (the "Property"); and

WHEREAS, the property possesses natural and scenic values of great importance to the Lessee; and

WHEREAS, the specific conservation values of the Property are documented in the Middle Soup Creek Project EIS dated __________ 19_____, attached hereto as Exhibit B and incorporated by this reference ("Baseline Documentation"), which consists of reports, maps, and other documentation that the parties agree provide, collectively, an accurate representation of the Property during the time of this lease and which is intended to serve as an objective information baseline for monitoring compliance with the terms of this lease; and

WHEREAS, Lessors intend, as owners of the Property, to convey to the Lessee for a period of 20 years, the right to preserve and protect the timber and other vegetation within the Middle Soup Creek Project Area.

(The language below is optional and should only be used if the high bidder is a tax exempt nonprofit organization.)

WHEREAS, Lessee is publicly supported, tax-exempt nonprofit organization, qualified under Section 501 © (3) and 170 (h) of the Internal Revenue Code, whose primary purpose is the preservation, protection, or enhancement of land in its natural, scenic historical, agricultural, forested, and/or open space conditions; and

WHEREAS, Lessee agrees by accepting this grant to honor the intentions of Lessors stated herein and to preserve and protect for 20 years the conservation values of the Property;

NOW, THEREFORE, in consideration of the above and the mutual covenants, terms, conditions, and restrictions contained herein, and pursuant to the laws of the State of Montana and in particular MCA 77-1-202, Lessors hereby lease to the Lessee a conservation lease for 20 years over the Property of the nature and character and to the extent hereinafter set forth ("Lease").

1. **Purpose.** It is the purpose of this Lease to assure that existing forest conditions be protected from fire and unnatural disturbances including timber harvesting on the Property for a period of 20 years from the date of signature and expire February 28, 2016.

Use if bid lump sum:

2. **Lease Rate.** ________Lump sum________________________

The Lessee shall pay to the Lessor a lump sum specified above upon issuance of this lease

Use if bid annual payment:

2. **Lease Rate.** ____________________annual payment for 20 years

The Lessee shall pay to the Lessor an annual payment specified above. The initial payment is due upon issuance of the lease. Payment 2 through 20 will be due March 1 of each year beginning with year ________. Failure to pay by April 1 of year (year) automatically cancels this lease. A notice of rental due will be sent to the address noted in paragraph 14 only, unless a change of address is requested in writing, signed by the Lessee and recorded by the Lessor.

3. **Rights of Lessee.** To accomplish the purpose of this Lease the following rights are conveyed to Lessee by this Lease:

(a) To preserve and protect the conservation values of the Property;

(b) To enter upon the Property at reasonable times in order to monitor Lessors compliance with and otherwise enforce the terms of the Lease; provided that such entry shall be upon prior reasonable notice to Lessors, and Lessee shall not unreasonably interfere with Lessors' use and enjoyment of the Property; and

4. **Prohibited Uses.** Any activity on or use by the Lessee of the Property inconsistent with the purpose of this Lease is prohibited.

5. **Reserved Rights.** Lessors reserve to themselves, and to their personal representative, heirs, successors, and assigns, all rights accruing from their ownership of the Property, including the right to engage in or to permit or invite others to engage in all uses of the Property that are not expressly prohibited herein and are not inconsistent with the purpose of this Lease.

6. **Notice of Intention to Undertake Certain Permitted Actions.** Lessors shall notify Lessee in writing not less than sixty (60) days prior to the date Lessors intend to exercise reserved rights that might have an adverse impact on the conservation values the Lease intended to protect.

7. **Remedies for Unauthorized Uses and Practices.** If Lessee determines that Lessors are in violation of the terms of this Lease

or that a violation is threatened, Lessee shall give written notice to Lessors of such violation and demand corrective action sufficient to cure the violation and, where the violation involves injury to this Lease, to restore the portion of the Property so injured. If Lessors fail to cure the violation within thirty (30) days after receipt of notice thereof from Lessee, or under circumstances where the violation cannot reasonably be cured within a thirty (30) day period, fail to begin curing such violation within the thirty (30) day period, or fail to continue diligently to cure such violation until finally cured, Lessee may bring an action at law or in equity in a court of competent jurisdiction to enforce the terms of this Lease, to enjoin the violation, by temporary or permanent injunction, to recover any damages to which it may be entitled for violation of the terms of the Lease or injury to any conservation values protected by this Lease and to require the restoration of the Property to the condition that existed prior to any such injury. Without limiting Lessors' liability therefor, Lessee, in its sole discretion, determines that circumstances require immediate action to prevent or mitigate significant damage to the conservation values of the Property, Lessee may pursue its remedies under this paragraph without prior notice to Lessors or without waiting for the period provided for cure to expire. Lessee's rights under this paragraph apply equally in the event of either actual or threatened violations of the terms of this Lease, and Lessors agree that Lessee's remedies at law for any violation of the terms of this Lease are inadequate and that Lessee shall be entitled to the injunctive relief described in this paragraph, both prohibitive and mandatory, in addition to such other terms of this Lease, without the necessity of proving either actual damages or the inadequacy of otherwise available legal remedies. Lessee's remedies described in this paragraph shall be cumulative and shall be in addition to all remedies now or hereafter existing at law of in equity.

8. **Acts Beyond Lessors' Control.** Nothing contained in this Lease shall be construed to entitle Lessee to being any action against Lessors for any injury to or change in the Property resulting from causes beyond Lessors' control, including, without limitation, fire, flood, storm, and earth movement, removal of timber through treaspass, or from any prudent action taken by Lessors under emergency conditions to prevent, abate, or mitigate significant injury to the Property resulting from such causes.

9. **Access.** No right of access by the general public to any portion of the Property is conveyed by this Lease.

10. **Hold Harmless and Indemnification.** The Lessor shall hold harmless, indemnify, and defend the Lessee and its employees, agents, and contractors from and against all liabilities,

penalties, costs, losses, damages, expenses, causes of action claims, demands of judgements, including without limitation, reasonable attorneys' fees, arising from or in any way connected with injury to or the death of any person, or physical damage to any property, resulting from any act, omission, condition, or other matter related to or occurring on or about the Land, regardless of cause, unless due to the negligence or willful misconduct of the Lessee or its agents, employees, or contractors.

The lessee similarly agrees to hold harmless, indemnify, and defend the Lessor and its employees, agents, and contractors from and against all liabilities, penalties, costs, losses, damages, expenses, causes of action claims, demands of judgements, including without limitation, reasonable attorneys' fees, arising from or in any way connected with injury to or the death of any person, or physical damage to any property, resulting from any act, omission, condition, or other matter related to or occurring on or about the Land, regardless of cause, unless due to the negligence or willful misconduct of the Lessor or its agents, employees, or contractors.

11. **Termination, Extinguishment.** It is the intention of the parties that the conservation purposes of this lease shall be carried out over the term of the lease. If circumstances arise during the term of the Lease that render the conservation purposes of this Lease impossible to accomplish, this Lease can only be

terminated or extinguished, whether in whole or in part, by mutual agreement or judicial proceedings in a court of competent jurisdiction.

12. **Amendment.** If circumstances arise under which an amendment to or modification of the Lease would be appropriate, the Lessor and the Lessee are free to jointly amend this Lease; provided that no amendment shall be allowed that will affect the qualifications of this lease under any applicable laws and any amendment shall be consistent with the purpose of this Lease.

13. **Assignment.** This Lease is assignable, after proper application has been made to and the written approval secured from the Lessor. Any attempt to transfer this license without the Lessor's written approval will result in the automatic termination of this agreement. Any assignment under this Paragraph must be only to an organization that is a qualified organization at the time of transfer under Section 170(h) of the Internal Revenue Code, as amended (or any successor provision then applicable), and the applicable regulations promulgated thereunder, and authorized to hold conservation leases under the laws of the state of Montana. As a condition of such transfer the, Lessor and Lessee require that the conservation purposes that this Lease is intended to advance continue to be carried out.

14. **General Provisions**

A. Controlling Law. The interpretation and performance of this Lease will be governed by the laws of the State of Montana.

B. Liberal Construction. Any general rule of construction to the contrary notwithstanding, this Lease shall be liberally construed in favor of the grant to effect the purpose of this Lease and the policy and purpose of Section 76-6-101, et, seg.,MCA. If any provision in this instrument is found to be ambiguous, an interpretation consistent with the purpose of this Lease that would render the provision valid shall be favored over any interpretation that would render it invalid.

C. Entire Agreement. This instrument sets forth the entire agreement of the parties with respect to the Lease and supersedes all prior discussions, negotiation, understandings, or agreements relating to the Lease, all of which are merged into this Lease.

D. Termination of Rights and Obligations. A party's rights and obligations under this Lease terminate upon transfer of the party's interest in the Lease or Land, except the liability for acts or omissions occurring prior to transfer shall survive transfer.

E. Severability. If any provision of this Lease is found to be invalid, the remainder of the provisions of this Lease shall not be affected.

15. **Notices.** Any notice, demand, request, consent, approval, or communication that either party desires or is required to give to the other shall be in writing and either served personally or sent by first class mail, postage prepaid, addressed as follows:

TO LESSOR: ______________________ TO LESSEE: ____________________

______________________ ____________________

______________________ ____________________

16. **Executory Limitation.** If Lessee shall cease to exist or to be a qualified organization under Section 170(h) of the Internal Revenue Code of 1954, as amended, or to be authorized to acquire and hold conservation leases under Montana Law, and a prior assignment is not made pursuant to paragraph 13, then the lease will be terminated immediately.

17. **Expiration/Termination.** The Lessee shall peaceably yield possession of these premises upon termination of this Lease for any cause.

IN WITNESS WHEREOF, the State of Montana and the Lessee have caused the Lease to be executed in duplicate and the Director of the Department of Natural Resources and Conservation, pursuant to the authority granted him by the State Board of Land Commissioners of the State of Montana, has hereunto set his hand and affixed the seal of the Board of Land Commissioners the ____________ day of

_____________, 19___.

Lessor

Arthur R. Clinch

Director Department of Natural Resources and Conservation

____

Lessee

____

____

Schedule of Exhibits

A. Legal Description of Property Subject to Lease

B. Baseline Documentation (site description/map)

Appendix D

MITIGATION MEASURES COMMON TO ALL ACTION ALTERNATIVES

The following mitigation measures are common to all action alternatives. They supplement the mitigations specific to each alternative which are described in Chapter II. Both specific and common mitigations are based on environmental laws, DNRC policies, DNRC standards and guidelines, consensus of scientific literature, and professional judgement. Implementing of these mitigations is intended to assure that each action alternative complies with pertinent environmental laws, policies, and standards and guidelines.

1. Grizzly Bear

   a. DNRC may immediately suspend all timber sale activities permitted in the contract if the suspension is necessary to prevent imminent confrontation or conflict between people and grizzly bears.

   b. All action alternatives meet the intent of the Swan Valley Grizzly Bear Conservation Agreement.

   c. Maintain travel corridors between areas providing suitable habitat.

   d. Consider the individual and cumulative effects of other land management actions within the analysis area of the proposed Middle Soup Creek Project.

   e. Seed disturbed soils along the first 0.5-1.0 miles of closed roads with unpalatable plant species to avoid attracting grizzly bears and other wildlife to reseeded areas along to open roads.

2. Elk and White-tailed Deer

   a. The purchaser is authorized to enter project area with motorized vehicles only for the purposes related to the performance of the contract. Road use is restricted to non-motorized transportation for any other purpose beyond any road closure. Motorized vehicle entry for purposes other than contract performance, such as hunting or transporting game animals will be considered in trespass and prosecuted to the fullest extent of the law (Administrative Rules of Montana 45-6-203).

b. Regardless of the harvest method, residue accumulation should not exceed 18 inches in depth to reduce the risk of impeding big game movement.

c. Apply brush disposal and site preparation treatments which will encourage production of desirable shrub species which are present.

d. To help maintain hiding cover, retain large trees either singly, in small groups, or in stringers. Retain clumps of sapling- to pole-size trees.

e. Maintain about 50 percent of upland habitat associated with riparian features in summer thermal cover, about 25 percent in hiding cover and about 25 percent as forage area.

f. Encourage development or maintenance of multispecies, multilayered stands in mixed conifer habitats adjacent to riparian features such as live streams, lakes, potholes, or areas where hydrophytic vegetation indicates a water table near the surface. Such stands should be at least 1.5 sight distances or 100 feet wide--whichever is greater--if the stand remains unmanaged.

g. To avoid the risk of trapping deer in the project area during fall and early winter, delay winter logging until January, or when snow depth exceeds 18 inches in the project area--whichever occurs first.

3. Aesthetics

a. Wherever possible, retain advanced regeneration and other natural vegetation along roads to screen views into cutting units and landings.

b. Slash damaged vegetation along roads, skidtrails, and landings.

c. Cleanup landing concurrent with timber harvesting activities to reduce the texture and color contrasts of curing vegetation and slash.

d. Seed grass on construction sites concurrently with harvesting to reduce color contrasts of displaced soil.

e. Whenever possible, use existing landings and skid trails to avoid building new ones.

f. Delay harvesting until winter to reduce soil disturbance and vegetation damage on skid trails and landings.

4. Water Quality and Fisheries

a. Limit the amount of activity in the watersheds to a level below which adverse cumulative impacts from water yield or sediment yield increases are anticipated.

b. Inventory and rehabilitate existing human-caused erosion sources in the watersheds and rehabilitate them.

c. Use the findings of the Flathead Basin Forest Practices Water Quality and Fisheries Cooperative Program to help design the project. Implement the recommendations of the study as agreed to in the Response of Major Forest Landowners to the "Study of Recommendations".

d. Apply BMP's to all aspects of the sale, including the design, layout, harvest, and post-harvest treatments. Modify BMP's as necessary for site-specific conditions.

e. Monitor implementation of BMP's through aggressive contract administration and interdisciplinary review.

f. Review with the MFWP fisheries biologist to determine specific habitat needs on a case-by-case basis.

Any additional monitoring of Soup Creek as agreed to between DNRC and MFWP will be entered in the Calendar Recall System (CRS)at the SRSF to assure follow-up. Additional information on the CRS can be obtained by contacting the SRSF.

5. Air Quality

Burning piles with moist fuels and high contents of dirt and duff increases smoke emissions. By piling with excavators, dirt and duff would be effectively sorted from logging residue and cleaner piles would result. Piled residue would cure at least one summer season before it is burned. Burning would occur in the fall when fuel moistures are usually at their lowest.

The following logging residue disposal methods would be used to minimize burning: (1) Under light-, moderate-, and heavy-reserve treatments, fifteen to twenty tons per acre of evenly distributed, large, down, woody material would be retained to promote site productivity; (2) In areas where fuel loads are light, residue would be lopped and scattered or machine-trampled.

DNRC is an active member of the Montana Airshed Group. This group has a comprehensive smoke management plan and regulates members' burning activities to minimize impacts to air quality. All burning would be conducted in accordance with the group's recommendations.

To minimize impacts to the Swan Lake area, no ignition would occur while winds are from the east or southeast.

6. Soils

Potential rutting, soil compaction, and displacement can be avoided or reduced by a combination of measures.

a. On harvest areas, limit equipment operations to periods when soils are adequately dry, frozen, or snow-covered.

b. Use existing skid trails where possible; locate additional skid trails only as needed to access timber. Plan skid trail systems to reduce traffic area. Skid trails should not exceed more than 15 percent of the harvest area.

c. For nutrient cycling and to maintain soil productivity, retain 10-15 tons/acre downed large woody material (over 3" dia.) on all harvest areas.

d. Existing roads would be repaired and maintained on a priority basis established by sediment survey and road use to comply with BMP's. Roads to be closed would have drainage features installed at critical locations to stabilize roads, prevent rutting and reduce erosion and sedimentation.

7. Noxious Weeds

To further limit the possible spread of weeds, the following integrated weed management mitigation measures of prevention and control will be implemented:

a. Clean road construction and skidding equipment of weed plant parts and mud prior to bringing on site.

b. Revegetate disturbed roadsides and landings with site-adapted grasses. For grass seeding to be effective it is important to complete seeding concurrent with road construction.

c. Control weeds along access roads by herbicide methods as designated by the forest officer in charge.

8. Herbicides

To reduce the risk to aquatic and terrestrial resources, the following will be required:

a. All herbicides will be applied by licensed applicators in accordance with the laws, rules, and regulations of the State of Montana and the Lake County Weed District.

b. All applications will adhere to Montana BMP's and the herbicide's specific label guidelines.

c. Herbicide application would not be general but site specific to areas along roads where noxious weeds occur. All no-spray areas will be designated on the ground before application begins.

d. Picloram would not be applied within fifty feet of surface water. 2,4,-D could be applied to within 25 feet of surface water. No herbicides would be applied within 25 feet of surface water.

e. Herbicides would not be applied to areas where relief may contribute runoff directly into surface water.

f. Application would occur on calm, dry days to limit drift and possible surface movement off road prisms.

9. Gray Wolves

a. If an active wolf den is located, proposed management activities within 1 mile of the den should be restricted through July 1.

b. Implement site-specific and cumulative effects considerations for big game species to assure perpetuation of a healthy prey base.

8. Soup Creek Campground

Cutting units will be screened from view of the campground.

9. Bald Eagles

DNRC will immediately suspend all timber sale activities permitted in the contact if the suspension is necessary to prevent disturbance to nesting, feeding, perching, roosting, or migration areas if these sites are located within the project area.

10. Cultural Resources

Should any cultural resource be encountered during any project activity, a DNRC archaeologist will be requested for a site specific review and recommendations and mitigations incorporated into the project planning process.

11. Plant Species of Special Concern

a. If the Purchaser, their contractors, subcontractors, or any of their employees encounter a plant community of special concern while operating in the project area, the Purchaser will immediately suspend

. all operations in the vicinity of the observation or discovery and immediately notify the forest officer.

b. Activities associated with tree harvesting and roads will not be allowed in meadows, bogs, or other required habitat associated with plant species of special concern.

12. Other

a. Prior to the letting of a timber sale agreement, the ID Team will review the proposed timber sale area for proper implementation of mitigation measures and other requirements detailed in the Middle Soup Creek Project Environmental Impact Statement.

b. Other interested groups or individuals will be given the opportunity for a field review of site-specific actions and implementation of mitigation measures prior to the letting of a timber sale agreement.

Interactions with Concerned Citizens, Groups, and Agencies

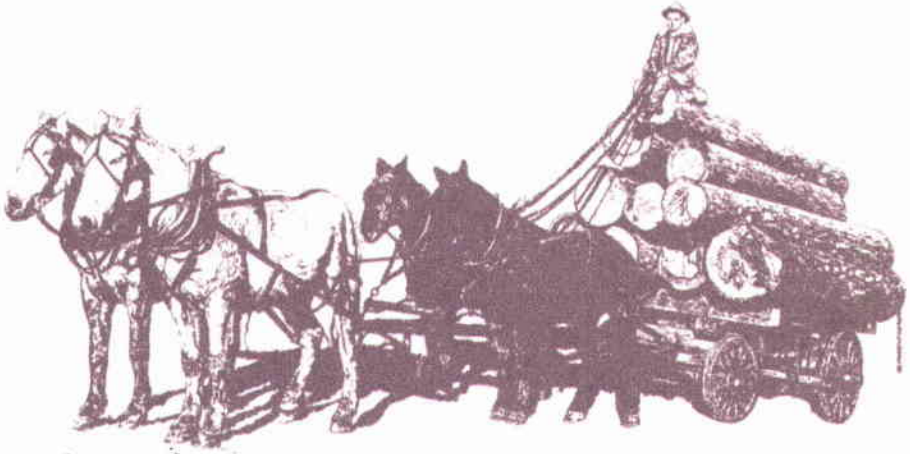
Date	Interaction
September 1994	★ The project proposal was mailed to interested individuals, owners of adjacent land, groups, private industry, and federal and state agencies (Appendix A) ★ Paid advertisements were sent to local papers (Appendix A) ★ A 30-day comment period began.
October 1994	★ Comments on the proposal were received from two landowners, Friends of the Wild Swan, the USFWS, DNRC land managers, and the ID team ★ Kevin Coats (MFWP) contacted Dan Hall (DNRC) to discuss the elk and white-tailed deer concern statement. He determined that it was sufficient. Kevin requested and received a copy of "Affected Environment" from the Middle Soup EA, the elk and white-tailed deer concern statement, and draft mitigation measures for the Middle Soup EIS ★ John Blair (Swan Valley landowner) stopped at SRSF Headquarters to request a Middle Soup project area map. A map was sent to him by mail.
March 1995	★ Glen Gray and Dan Hall (DNRC), met with Arlene Montgomery (Friends of the Wild Swan) and Ron Bader (Swan Valley landowner) to discuss their comments on the project proposal. An agreement on how their concerns would be addressed in the EIS was reached.
May 1995	★ Arlene Montgomery, Ron Bader, and DNRC project leaders conducted a field reconnaissance to explore the definitions of old growth. Everyone agreed that the examined stands classified as "non-old growth" were not old growth. Because of time restrictions, only two stands were examined.
June 1995	★ As a result of the May field review, DNRC identified ten additional stands not classified as old growth in the SRSF Stand Level Inventory; however, based on its improved understanding of Friends of the Wild Swan's definition of old growth, DNRC dismissed the stands from consideration to resolve the major resource concern "old growth preservation." A map of stand locations and reasons why the stands were dismissed were mailed to Arlene Montgomery and Ron Bader on July 6, 1995.
July 1995	★ DNRC, Arlene Montgomery, and Ron Bader conducted a second field reconnaissance to consider the two stands still slated for timber harvesting. Arlene and Ron suggested that a road constructed to access one of the stands would result in cutting old growth and would further fragment the area. They recommended helicopter logging in lieu of road construction. Arlene also suggested that treating the two stands might impact the integrity of adjacent old-growth stands. Arlene decided to discuss her concerns with Sara Johnson, wildlife consultant to Friends of the Wild Swan, before agreeing to the proposed treatments for the two stands.
August 1995	★ Arlene informed DNRC that she and Sara Johnson recommended no treatment for the two stands.
September 1996	★ Draft EIS issued for public review and comment. A public hearing will be held. The comment period will be 45 days long.
November 1996	★ Final EIS available for public review.
November 1996	The finding issued.

STAND SUCCESSIONAL PROGRESSIONS

TIME →

	Current Conditions	After Harvest	20 Years	50 Years	150 Years
	Nonforest	→	→	→	→
(3)	Grass/seedling/sapling	→	Sapling	Old Pole	Saw Timber
(15)	Sapling	→	Young Pole	Saw Timber	→
(30)	Young Pole	→	Old Pole	Saw Timber	→
(50)	Old Pole	→	Saw Timber	→	Old Growth
verstory 200) derstory 15)	Multistory	→	→	Saw Timber	Old Growth
	Light Reserve	Sapling	Young Pole	Saw Timber	→
	Moderate Reserve	Sapling	Young Pole	Saw Timber	→
(100)	Saw Timber	→	→	→	Old Growth
	Light Reserve	Grass/Seedling/Sapling	Sapling	Old Pole	Saw Timber
	Moderate Reserve	Grass/Seedling/Sapling	Sapling	Old Pole	Saw Timber
	Heavy Reserve	Saw Timber	→	→	Old Growth
	Old Growth (Not Harvested)	→	→	→	→
(200)	With Vigor Value = 2	Old Growth	→	→	→
(300)	With Vigor Value = 3	Old Growth	→	→	Post Old Growtl
(400)	With Vigor Value = 4	Old Growth	→	Post Old Growth	→
	Old Growth				
	Light Reserve	Grass/Seedling/Sapling	Sapling	Old Pole	Saw Timber
	Moderate Reserve	Grass/Seedling/Sapling	Sapling	Old Pole	Saw Timber
	Heavy Reserve				
(200)	With Vigor Value = 2	Saw Timber	→	Old Growth	→
(300)	With Vigor Value = 3	Saw Timber	→	Old Growth	Post Old Growth
(400)	With Vigor Value = 4	Saw Timber	→	Post Old Growth	→

Numbers in ( ) indicate stand age at current condition



MIDDLE SOUP CREEK PROJECT

Draft Environmental Impact Statement
Deparment of Natural Resources and Conservation
Northwest Land Office

Swan River State Forest

Swan Lake, Montana 59911

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